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Convenient, DBU-promoted anti-Markovnikov hydration of 2-methyl-1-(3-arylprop-2-yn-1-yl)-1*H*-imidazoles in wet NMP

Alexei Lukin, Anna Nichugovskaya, Lyubov Vinogradova, Kristina Komarova, Saeed Balalaie, Dmitry Dar'in and Mikhail Krasavin

Contents:

*General procedure for the preparation of compounds **1a-m**:* *N*-Prop-2-yn-1-yl amide **5** (0.46 mmol) was dissolved in anhydrous toluene (15 ml). Amine **6** (0.92 mmol) and $Zn(OTf)_2$ (0.12 mmol) were added, and the reaction mixture was heated at reflux for 18 h. Upon cooling to room temperature, the solvent was removed *in vacuo*. The residue was dissolved in ethyl acetate (30 mL) and the solution was extracted with 5% aq. K_2CO_3 (2 × 25 ml). The organic phase was dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo*. Chromatography on silica gel using 0→1% methanol in chloroform as eluent afforded the desired compound.

*General procedure for the preparation of compounds **4a-m**:* Imidazole **1** (0.37 mmol) was placed in a 10 ml screw-cap vessel. NMP (1 ml) and DBU (0.74 mmol) were added, the vessel was capped and placed in a 177 °C oil bath. The reaction mixture was heated at that temperature with stirring over 4 hours. Upon cooling to room temperature, the reaction mixture was diluted with ethyl acetate (10 ml) and the resulting organic phase was extracted with water (3 × 15 ml). The organic phase was dried over anhydrous Na_2SO_4, filtered and concentrated *in vacuo*. Chromatography on silica gel using 0→1% methanol in chloroform as eluent afforded the desired compound.

5-Methyl-2-phenyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1a)

Yield 0.073 g (58%), beige solid, m.p. 94-95 °C. ^{1}H NMR (300 MHz, DMSO) δ 7.69 (d, J = 7.8 Hz, 2H), 7.53 (t, J = 7.4 Hz, 2H), 7.48 – 7.37 (m, 6H), 6.82 (s, 1H), 5.03 (s, 2H), 2.37 (s, 3H); ^{13}C NMR (75 MHz, DMSO) δ 146.2, 131.5, 130.9, 129.0, 128.7, 128.7, 128.4, 128.1, 126.0, 121.3, 84.4, 84.1, 34.7, 9.4; HRMS (ESI), m/z calcd for $C_{19}H_{17}N_2$ [M+H$^+$] 273.1392 Da, found 273.1386 Da.

2-(4-Bromophenyl)-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1b)

Yield 0.110 g (40%), beige solid, m.p. 114-115 °C. ^{1}H NMR (300 MHz, DMSO) δ 7.74 (d, J = 8.6 Hz, 2H), 7.64 (d, J = 8.6 Hz, 2H), 7.46 – 7.36 (m, 5H), 6.84 (s, 1H), 5.05 (s, 2H), 2.36 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 147.2, 132.1, 131.9, 130.3, 129.7, 129.2, 128.6, 126.7, 123.3, 121.9, 85.7, 82.9, 35.5, 10.1; HRMS (ESI), m/z calcd for $C_{19}H_{16}BrN_2$ [M+H$^+$] 351.0497 Da, found 351.0491 Da.

5-Methyl-1-[3-(2-methylphenyl)prop-2-yn-1-yl]-2-phenyl-1*H*-imidazole (1c)

Yield 0.115 g (79%), beige solid, m.p. 78-79 °C. ^{1}H NMR (300 MHz, DMSO) δ 7.75 – 7.67 (m, 2H), 7.56 – 7.37 (m, 4H), 7.31 – 7.24 (m, 2H), 7.22 – 7.14 (m, 1H), 6.82 (s, 1H), 5.07 (s, 2H), 2.38 (s, 3H), 2.31 (s, 3H); ^{13}C NMR (75 MHz, DMSO) δ 146.2, 139.8, 131.9, 130.9, 129.6, 129.0, 128.7, 128.4, 128.0, 126.0, 125.9, 121.2, 88.4, 83.0, 34.8, 20.1, 9.4; HRMS (ESI), m/z calcd for $C_{20}H_{19}N_2$ [M+H$^+$] 287.1548 Da, found 287.1543 Da.

5-Methyl-1-[3-(1-naphthyl)prop-2-yn-1-yl]-2-phenyl-1*H*-imidazole (1d)

Yield 0.090 g (80%), beige solid, m.p. 109-110 °C. ^{1}H NMR (300 MHz, DMSO) δ 8.06 – 7.95 (m, 3H), 7.77 (d, J = 7.1 Hz, 2H), 7.71 (d, J = 7.0 Hz, 1H), 7.63 – 7.46 (m, 6H), 6.85 (s, 1H), 5.23 (s, 2H), 2.43 (s, 3H); ^{13}C NMR (75 MHz, DMSO) δ 146.3, 132.7, 132.5, 131.0, 130.8, 129.4, 129.1, 128.7, 128.5, 128.4, 128.1, 127.3, 126.7, 126.1, 125.5, 124.9, 118.7, 82.0, 79.1, 34.9, 9.5; HRMS (ESI), m/z calcd for $C_{23}H_{21}N_2$ [M+H$^+$] 325.1705 Da, found 325.1743 Da.

2-Benzyl-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1e)

Yield 0.087 g (40%), brown oil. ^{1}H NMR (300 MHz, DMSO) δ 7.39 – 7.25 (m, 9H), 7.22 – 7.16 (m, 1H), 6.61 (s, 1H), 4.96 (s, 2H), 4.12 (s, 2H), 2.24 (s, 3H); 13C NMR (75 MHz, DMSO) δ 145.6, 137.9, 131.5, 128.9, 128.6, 128.5, 128.3, 127.3, 126.2, 124.6, 121.5, 84.2, 83.3, 33.2, 32.8, 9.4; HRMS (ESI), m/z calcd for $C_{20}H_{18}N_2$ [M+H$^+$] 287.1548 Da, found 287.1543 Da.

2-(2-Furyl)-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1f)

Yield 0,020 g (10%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.54 (s, 1H), 7.41 – 7.36 (m, 2H), 7.33 – 7.29 (m, 3H), 6.95 (d, J = 3.3 Hz, 1H), 6.90 (s, 1H), 6.53 (dd, J = 3.2, 1.7 Hz, 1H), 5.11 (s, 2H), 2.39 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 145.4, 142.9, 138.7, 131.9, 129.0, 128.9, 128.5, 126.5, 122.1, 111.7, 109.8, 84.9, 82.7, 35.1, 9.9; HRMS (ESI), m/z calcd for $C_{17}H_{14}N_2O$ [M+H$^+$] 263.1184 Da, found 263.1180 Da.

5-Methyl-1-(3-phenylprop-2-yn-1-yl)-2-(2-thienyl)-1*H*-imidazole (1g)

Yield 0,130 g (60%), beige solid, m.p. 94-95 °C. ^{1}H NMR (300 MHz, DMSO) δ 7.63 (d, J = 5.1 Hz, 1H), 7.51 (d, J = 3.1 Hz, 1H), 7.45 – 7.36 (m, 5H), 7.21 (dd, J = 5.0, 3.6 Hz, 1H), 6.81 (s, 1H), 5.17 (s, 2H), 2.34 (s, 3H); ^{13}C NMR (75 MHz, DMSO) δ 146.3, 133.3, 131.5, 131.2, 129.1, 128.7, 128.0, 127.0, 126.8, 125.0, 121.3, 84.1, 84.1, 34.7, 9.6; HRMS (ESI), m/z calcd for $C_{17}H_{14}N_2S$ [M+H$^+$] 279.0956 Da, found 279.0950 Da.

2-Cyclohexyl-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1h)

Yield 0,250 g (79%), brown oil. ^{1}H NMR (300 MHz, DMSO) δ 7.45 – 7.34 (m, 5H), 6.52 (d, J = 1.0 Hz, 1H), 4.99 (s, 2H), 2.89 – 2.73 (m, 1H), 2.22 (d, J = 0.9 Hz, 3H), 1.90 – 1.63 (m, 5H), 1.57 – 1.29 (m, 4H), 1.28 – 1.14 (m, 1,3H), 1.11 (s, 0,2H), 1.05 (t, J = 7.0 Hz, 0,5H); ^{13}C NMR (75 MHz, DMSO) δ 151.1, 131.4, 129.0, 128.8, 126.3, 124.1, 121.6, 85.0, 83.3, 35.1, 32.6, 31.8, 25.8, 25.6, 9.3; HRMS (ESI), m/z calcd for $C_{19}H_{22}N_2$ [M+Na$^+$] 301.1681 Da, found 301.1675 Da.

2-Cyclopentyl-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1i)

Yield 0,140 g (56%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.34 (m, 2H), 7.30 – 7.26 (m, 3H), 6.67 (s, 1H), 4.75 (s, 2H), 3.15 (p, J = 8.1 Hz, 1H), 2.26 (d, J = 0.9 Hz, 3H), 2.12 – 2.00 (m, 2H), 2.00 – 1.90 (m, 2H), 1.87 – 1.77 (m, 2H), 1.69 – 1.59 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 151.2, 131.6, 128.7, 128.3, 127.0, 124.4, 122.0, 84.3, 83.0, 37.2, 33.4, 31.9, 25.6, 9.7; HRMS (ESI), m/z calcd for $C_{18}H_{20}N_2$ [M+Na$^+$] 287.1524 Da, found 287.1519 Da.

2-Cyclobutyl-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1j)

Yield 0,128 g (38%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 2H), 7.31 – 7.25 (m, 3H), 6.69 (s, 1H), 4.64 (s, 2H), 3.60 (p, J = 8.5 Hz, 1H), 2.53 – 2.31 (m, 4H), 2.25 (s, 3H), 2.10 – 1.89 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 150.5, 131.6, 128.7, 128.3, 127.1, 124.6, 122.0, 84.2, 82.8, 33.2, 32.3, 27.4, 18.7, 9.6; HRMS (ESI), m/z calcd for $C_{17}H_{19}N_2Na$ [M+Na$^+$] 273.1368 Da, found 273.1362 Da.

2-Cyclopropyl-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1k)

Yield 0,180 g (80%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.41 – 7.34 (m, 2H), 7.31 – 7.25 (m, 3H), 6.61 (s, 1H), 4.88 (s, 2H), 2.27 (s, 3H), 1.93 – 1.81 (m, 1H), 1.06 – 0.87 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 148.7, 131.7, 128.8, 128.4, 127.2, 124.3, 122.1, 84.4, 82.8, 33.4, 9.7, 7.5, 6.3; HRMS (ESI), m/z calcd for $C_{16}H_{16}N_2$ [M+H$^+$] 237.1392 Da, found 237.1386 Da.

2,5-Dimethyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1l)

Yield 0,081 g (41%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.37 – 7.31 (m, 2H), 7.29 – 7.23 (m, 3H), 6.61 (s, 1H), 4.67 (s, 2H), 2.41 (s, 3H), 2.23 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 144.1, 131.6, 128.7, 128.3, 127.0, 124.5, 121.9, 84.4, 82.3, 33.7, 13.5, 9.7; HRMS (ESI), m/z calcd for $C_{14}H_{14}N_2$ [M+H$^+$] 211.1235 Da, found 211.1235 Da.

2-(1-Adamantyl)-5-methyl-1-(3-phenylprop-2-yn-1-yl)-1*H*-imidazole (1m)

Yield 0,090 g (29%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.33 (m, 2H), 7.31 – 7.26 (m, 3H), 6.69 (s, 1H), 4.98 (s, 2H), 2.27 (s, 3H), 2.18 – 2.14 (m, 4H), 2.09 (s, 2H), 1.85 (d, J = 2.5 Hz, 2H), 1.78 – 1.76 (m, 4H), 1.69 (s, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 153.3, 131.7, 128.8, 128.4, 127.7, 123.9, 122.1, 84.8, 83.4, 41.0, 36.7, 36.5, 35.5, 28.5, 9.8; HRMS (ESI), m/z calcd for $C_{23}H_{26}N_2$ [M+H$^+$] 331.2174 Da, found 331.2169 Da.

1-(5-Methyl-2-phenyl-1H-imidazol-1-yl)-3-phenylacetone (4a)

Yield 0.05 g (50%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.35 – 7.27 (m, 8H), 7.18 – 7.13 (m, 2H), 6.86 (s, 1H), 4.70 (s, 2H), 3.68 (s, 2H), 1.96 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.4, 148.0, 132.5, 130.6, 129.2, 129.1, 128.9, 128.8, 128.6, 128.5, 127.7, 126.3, 52.7, 47.4, 9.5; HRMS (ESI), m/z calcd for $C_{20}H_{18}N_2O$ [M+H$^+$] 291.1497 Da, found 291.1492 Da.

1-[2-(4-Bromophenyl)-5-methyl-1*H*-imidazol-1-yl]-3-phenylacetone (4b)

Yield 0.025 g (86%), brown oil. ^{1}H NMR (300 MHz, DMSO) δ 7.57 – 7.48 (m, 2H), 7.37 – 7.26 (m, 3H), 7.26 – 7.17 (m, 4H), 6.77 (s, 1H), 5.07 (s, 2H), 3.90 (s, 2H), 2.00 (s, 3H); ^{13}C NMR (75 MHz, DMSO) δ 202.7, 145.8, 133.7, 131.6, 129.9, 129.7, 128.6, 127.0, 125.7, 121.9, 52.9, 46.2, 9.2; HRMS (ESI), m/z calcd for $C_{19}H_{17}BrN_2O$ [M+H$^+$] 369.0603 Da, found 369.0597 Da.

1-(2-Methylphenyl)-3-(5-methyl-2-phenyl-1*H*-imidazol-1-yl)acetone (4c)

Yield 0.010 g (29%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.42 – 7.30 (m, 5H), 7.23 – 7.05 (m, 4H), 6.89 (s, 1H), 4.69 (s, 2H), 3.72 (s, 2H), 2.18 (s, 3H), 2.03 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.2, 148.0, 136.9, 131.3, 131.0, 130.4, 129.2, 129.0, 128.8, 128.7, 128.2, 126.8, 126.0, 52.8, 45.8, 19.7, 9.7; HRMS (ESI), m/z calcd for $C_{20}H_{20}N_2O$ [M+H$^+$] 305.1654 Da, found 305.1648 Da.

1-(5-Methyl-2-phenyl-1*H*-imidazol-1-yl)-3-(1-naphthyl)acetone (4d)

Yield 0.025 g (47%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.92 – 7.79 (m, 3H), 7.57 – 7.49 (m, 2H), 7.46 – 7.28 (m, 3H), 7.24 – 7.12 (m, 4H), 6.85 (s, 1H), 4.65 (s, 2H), 4.17 (s, 2H), 1.90 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.8, 148.1, 134.11, 132.0, 130.5, 129.2, 128.9, 128.9, 128.6, 128.6, 127.2, 126.4, 126.2, 125.8, 123.5, 52.6, 46.3, 9.6; HRMS (ESI), m/z calcd for $C_{23}H_{20}N_2O$ [M+H$^+$] 341.1654 Da, found 341.1648 Da.

1-(2-Benzyl-5-methyl-1*H*-imidazol-1-yl)-3-phenylacetone (4e)

Yield 0.020 g (38%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.31 (m, 3H), 7.25 – 7.16 (m, 3H), 7.11 – 7.04 (m, 2H), 7.02 – 6.95 (m, 2H), 6.77 (s, 1H), 4.42 (s, 2H), 3.89 (s, 2H), 3.45 (s, 2H), 1.92 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 200.7, 146.3, 136.8, 132.5, 129.4, 129.3, 128.9, 128.5, 128.2, 127.9, 127.0, 124.7, 51.60, 47.3, 34.2, 9.5; HRMS (ESI), m/z calcd for $C_{20}H_{20}N_2O$ [M+H$^+$] 305.1654 Da, found 305.1648 Da.

1-[2-(2-Furyl)-5-methyl-1*H*-imidazol-1-yl]-3-phenylacetone (4f)

Yield 0.006 g (46%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.40 – 7.30 (m, 3H), 7.24 – 7.18 (m, 3H), 6.93 (d, J = 3.1 Hz, 1H), 6.88 (s, 1H), 6.44 (dd, J = 3.4, 1.8 Hz, 1H), 4.97 (s, 2H), 3.78 (s, 2H), 1.99 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 200.7, 142.8, 138.6, 132.6, 129.5, 129.3, 129.2, 129.0, 128.9, 127.9, 125.0, 112.1, 53.0, 47.4, 9.4; HRMS (ESI), m/z calcd for $C_{17}H_{16}N_2O_2$ [M+H$^+$] 281.1290 Da, found 281.1286 Da.

1-[5-Methyl-2-(2-thienyl)-1*H*-imidazol-1-yl]-3-phenylacetone (4g)

Yield 0.034 g (64%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.28 (m, 4H), 7.23 – 7.15 (m, 2H), 6.97 – 6.90 (m, 1H), 6.86 (s, 1H), 6.81 (d, J = 3.5 Hz, 1H), 4.81 (s, 2H), 3.75 (s, 2H), 1.96 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.2, 142.0, 132.4, 129.5, 129.4, 129.3, 127.9, 127.5, 126.9, 126.8, 126.0, 52.7, 47.5, 9.6; HRMS (ESI), m/z calcd for $C_{17}H_{16}N_2OS$ [M+H$^+$] 297.1062 Da, found 297.1056 Da.

1-(2-Cyclohexyl-5-methyl-1*H*-imidazol-1-yl)-3-phenylacetone (4h)

Yield **(5.8)** 0.040 g (25%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 – 7.29 (m, 3H), 7.20 (d, J = 6.5 Hz, 2H), 6.67 (s, 1H), 4.58 (s, 2H), 3.71 (s, 2H), 2.02 (tt, J = 11.3, 3.6 Hz, 1H), 1.90 (s, 3H), 1.76 – 1.50 (m, 7H), 1.25 – 1.05 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.5, 152.2, 132.7, 129.3, 129.2, 127.8, 126.6, 124.9, 50.8, 47.4, 36.3, 31.9, 26.3, 25.8, 9.4; HRMS (ESI), m/z calcd for $C_{19}H_{24}N_2O$ [M+H$^+$] 297.1967 Da, found 297.1961 Da.

1-(2-Cyclopentyl-5-methyl-1*H*-imidazol-1-yl)-3-phenylacetone (4i)

Yield **(5.9)** 0.054 g (50%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 – 7.27 (m, 3H), 7.22 – 7.15 (m, 2H), 6.65 (s, 1H), 4.59 (s, 2H), 3.70 (s, 2H), 2.59 – 2.45 (m, 1H), 1.89 (s, 3H), 1.80 – 1.69 (m, 6H), 1.53 – 1.42 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.5, 151.7, 132.6, 129.3, 129.2, 127.8, 127.1, 124.7, 51.1, 47.4, 37.1, 31.8, 25.5, 9.4; HRMS (ESI), m/z calcd for $C_{18}H_{22}N_2O$ [M+H$^+$] 283.1810 Da, found 283.1805 Da.

1-(2-Cyclobutyl-5-methyl-1*H*-imidazol-1-yl)-3-phenylacetone (4j)

Yield **(5.10)** 0.050 g (50%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.41 – 7.28 (m, 3H), 7.20 (d, J = 6.6 Hz, 2H), 6.73 (s, 1H), 4.51 (s, 2H), 3.70 (s, 2H), 3.13 – 3.00 (m, 1H), 2.45 – 2.29 (m, 2H), 2.15 – 2.03 (m, 2H), 1.92 (s, 3H), 1.90 – 1.80 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.2, 151.0, 132.6, 129.4, 129.3, 127.9, 127.5, 124.4, 51.2, 47.5, 32.1, 27.4, 18.7, 9.4; HRMS (ESI), m/z calcd for $C_{17}H_{20}N_2O$ [M+H$^+$] 269.1654 Da, found 269.1648 Da.

1-(2-Cyclopropyl-5-methyl-1*H*-imidazol-1-yl)-3-phenylacetone (4k)

Yield **(5.11)** 0.039 g (63%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 – 7.28 (m, 3H), 7.23 – 7.16 (m, 2H), 6.60 (s, 1H), 4.70 (s, 2H), 3.73 (s, 2H), 1.90 (s, 3H), 1.39 – 1.28 (m, 1H), 0.88 – 0.81 (m, 2H), 0.76 – 0.67 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.6, 149.1, 132.7, 129.4, 129.2, 127.8, 127.4, 124.6, 51.3, 47.4, 9.4, 7.3, 6.2; HRMS (ESI), m/z calcd for $C_{16}H_{18}N_2O$ [M+H$^+$] 255.1497 Da, found 255.1492 Da.

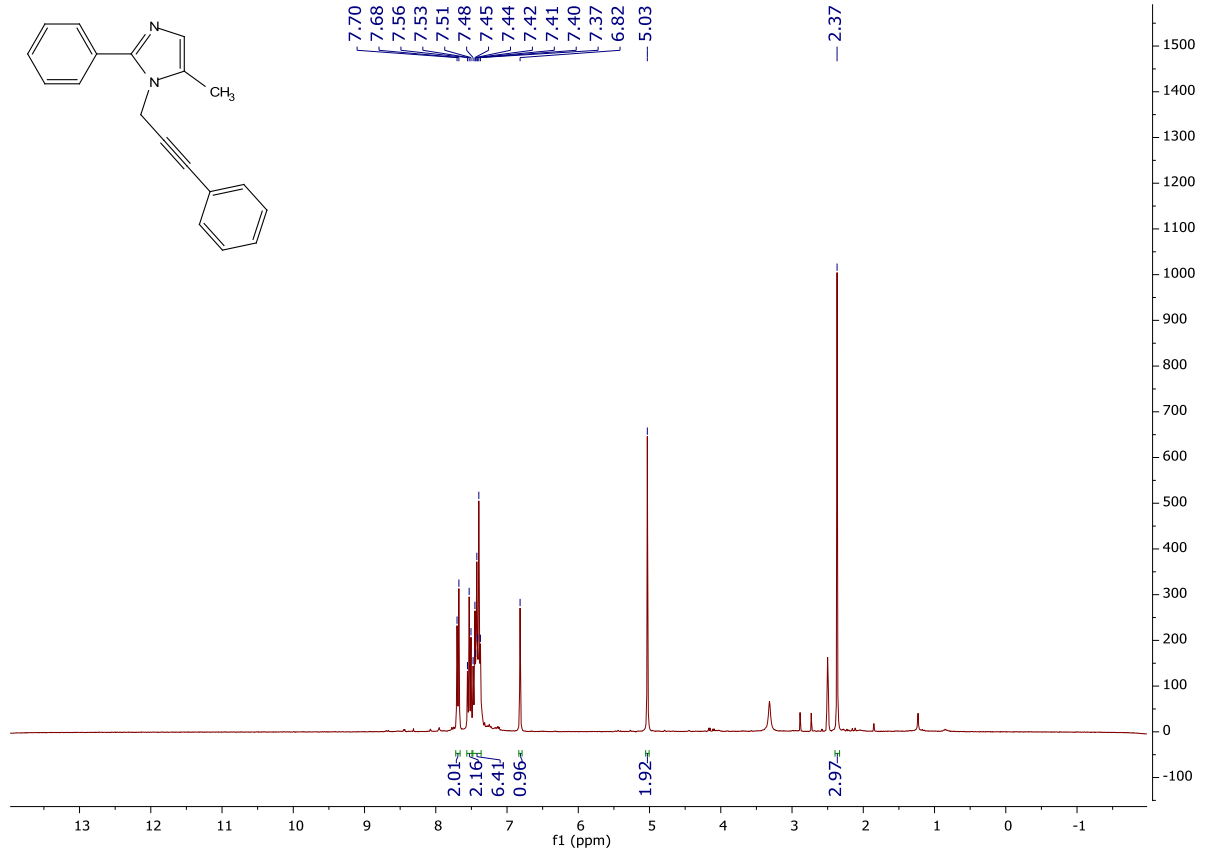
1-(2,5-Dimethyl-1*H*-imidazol-1-yl)-3-phenylacetone (4l)

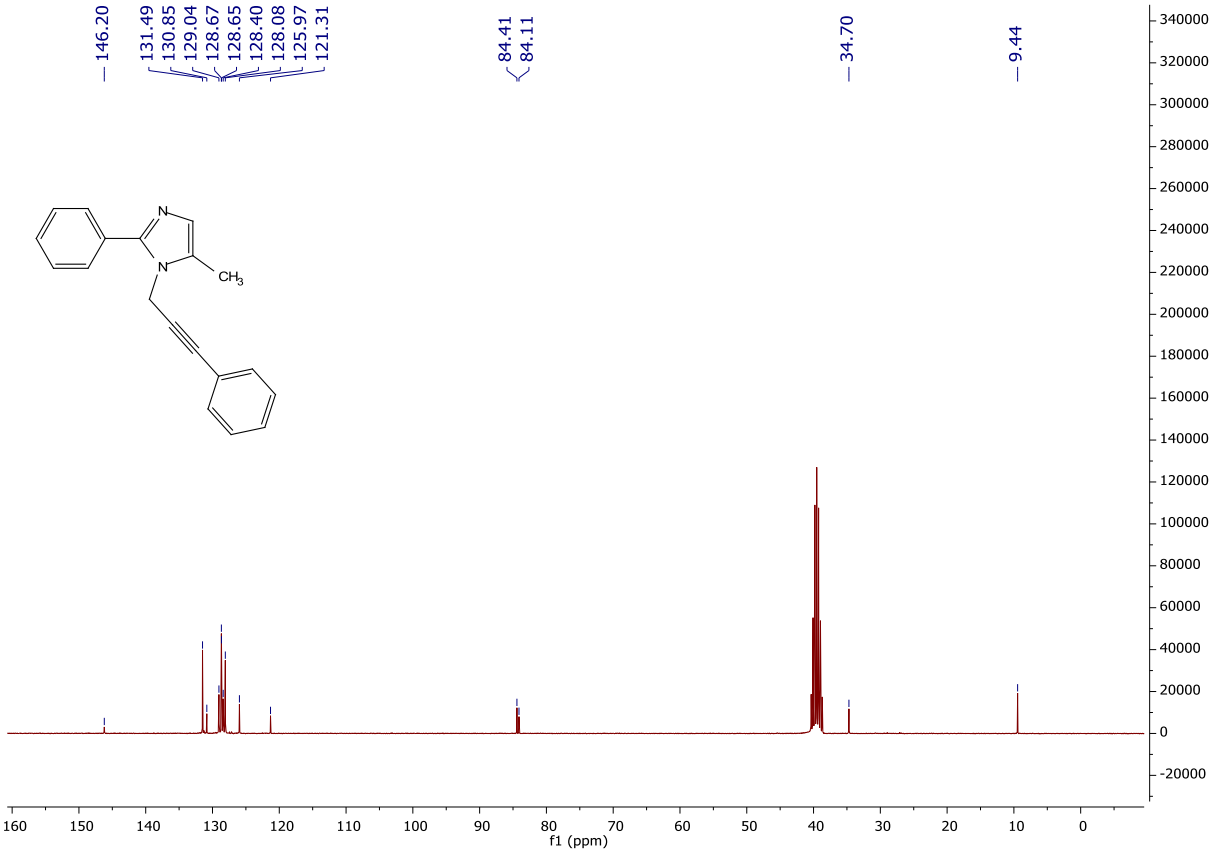
Yield 0.024 g (44%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38 – 7.28 (m, 3H), 7.17 (d, J = 6.6 Hz, 2H), 6.63 (s, 1H), 4.54 (s, 2H), 3.70 (s, 2H), 2.07 (s, 3H), 1.89 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 201.2, 144.6, 132.5, 129.3, 129.2, 127.9, 127.2, 124.5, 51.5, 47.4, 13.1, 9.5; HRMS (ESI), m/z calcd for $C_{14}H_{16}N_2O$ [M+Na$^+$] 251.1160 Da, found 251.1155 Da.

1-[2-(1-Adamantyl)-5-methyl-1*H*-imidazol-1-yl]-3-phenylacetone (4m)

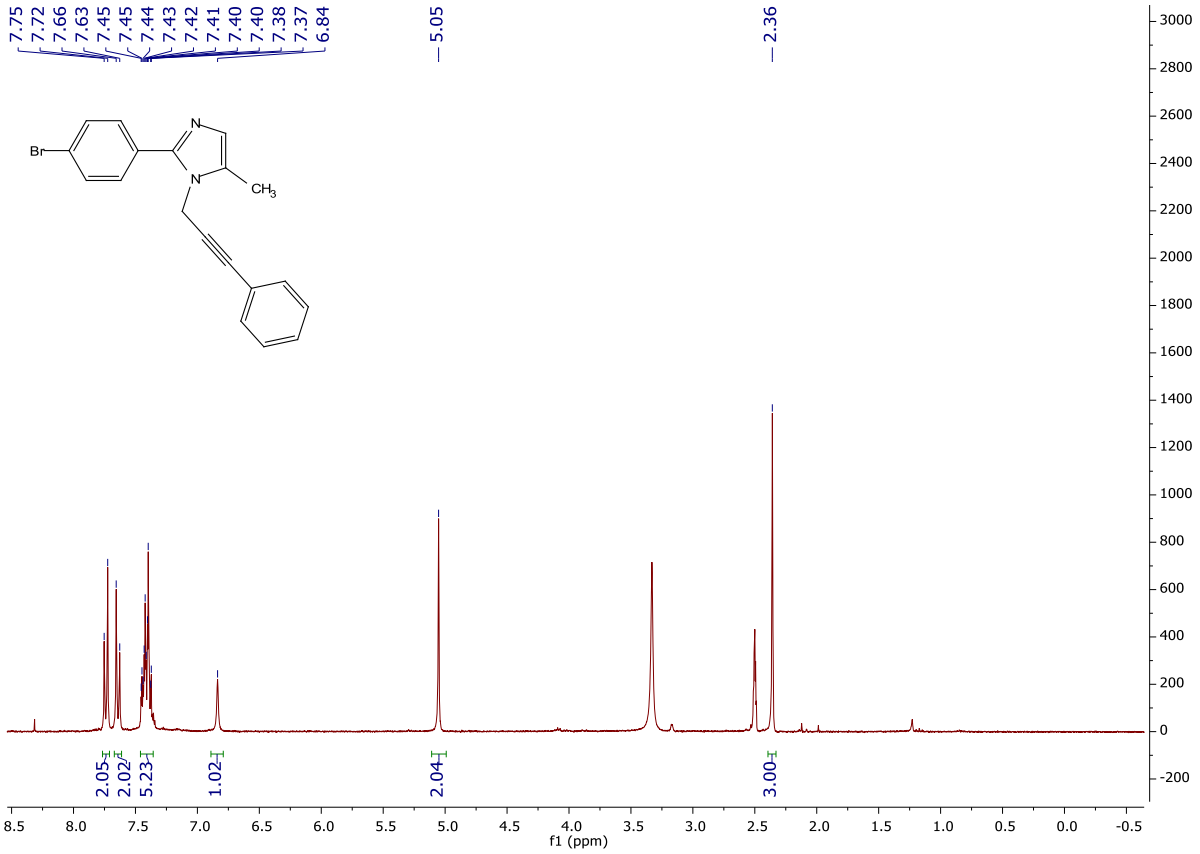
Yield **(5.13)** 0.030 g (40%), brown oil. ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.42 – 7.27 (m, 5H), 6.87 (s, 1H), 4.94 (s, 2H), 3.80 (s, 2H), 1.97 – 1.93 (m, 3H), 1.92 (s, 3H), 1.86 (br.s, 4H), 1.73 – 1.52 (m, 8H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 198.8, 152.3, 132.1, 130.2, 129.7, 129.5, 128.7, 128.5, 53.3, 48.1, 39.8, 36.6, 35.9, 27.8, 9.5; HRMS (ESI), m/z calcd for $C_{23}H_{28}N_2O$ [$M+H^+$] 349.2280 Da, found 349.2274 Da.

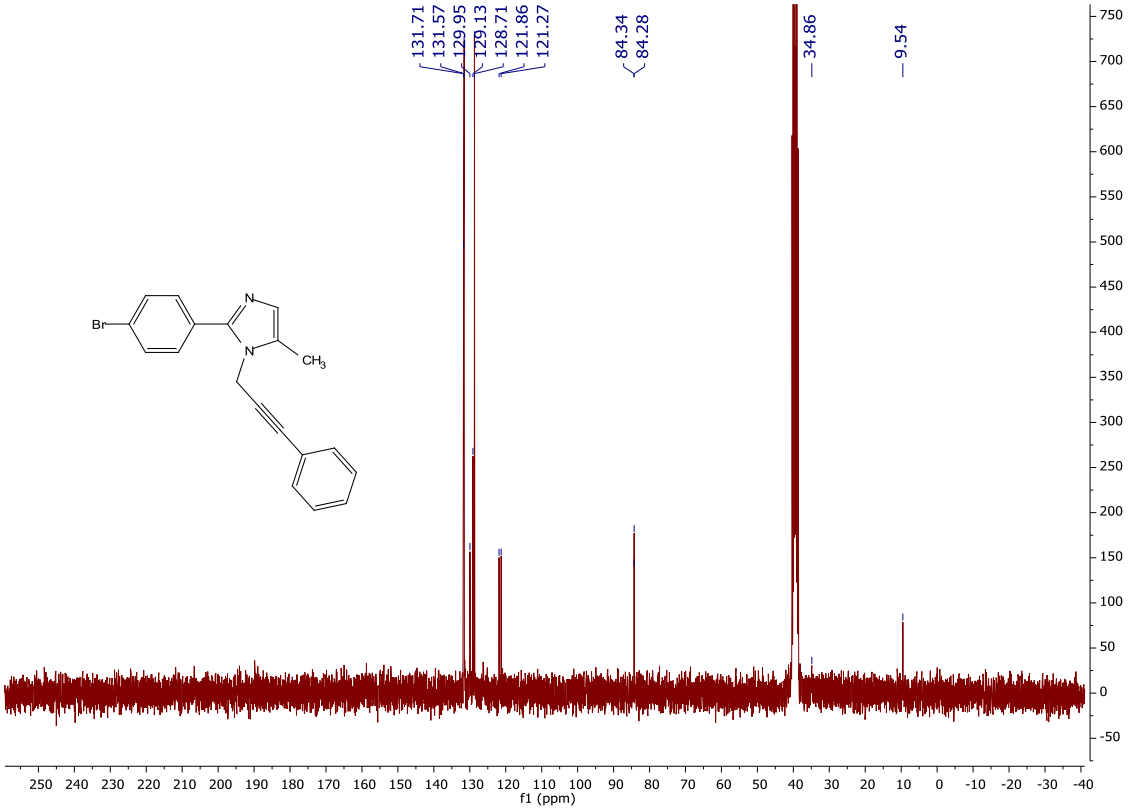
^{1}H and ^{13}C NMR spectra of compound **1a**



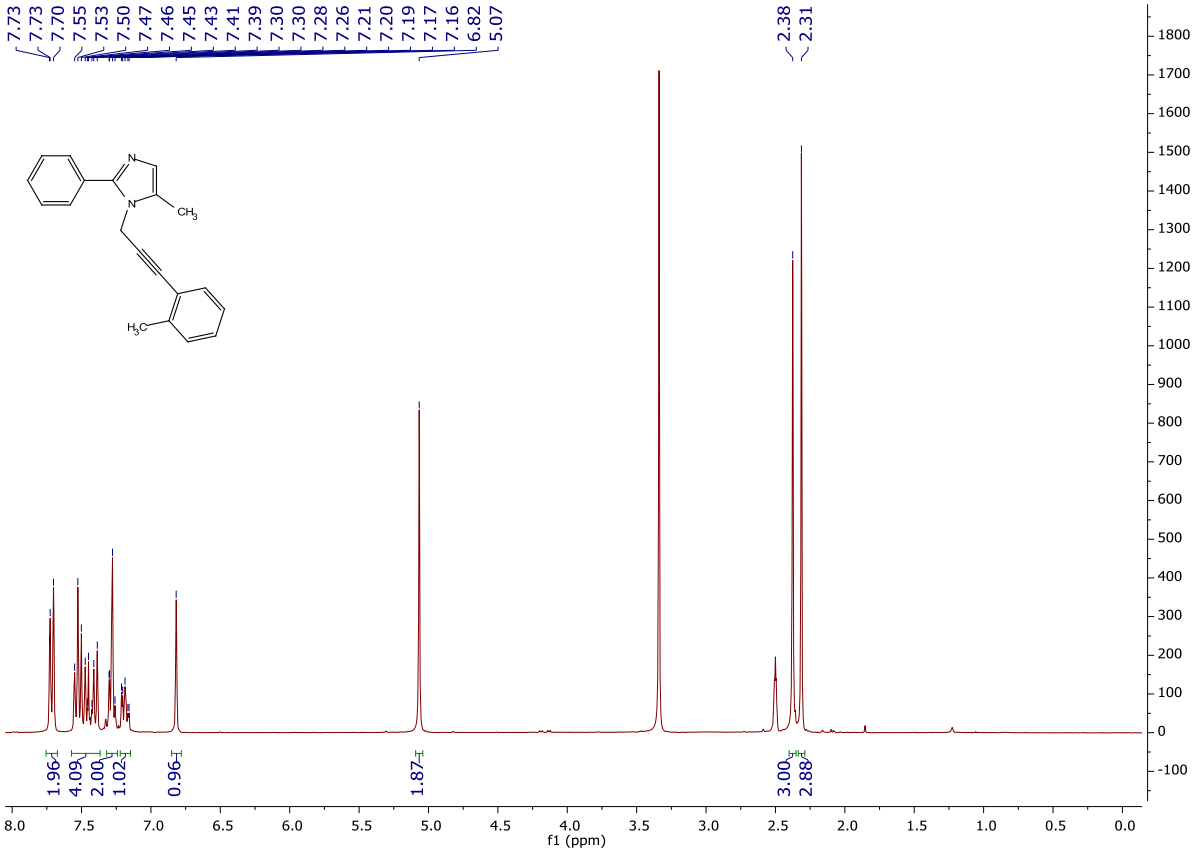


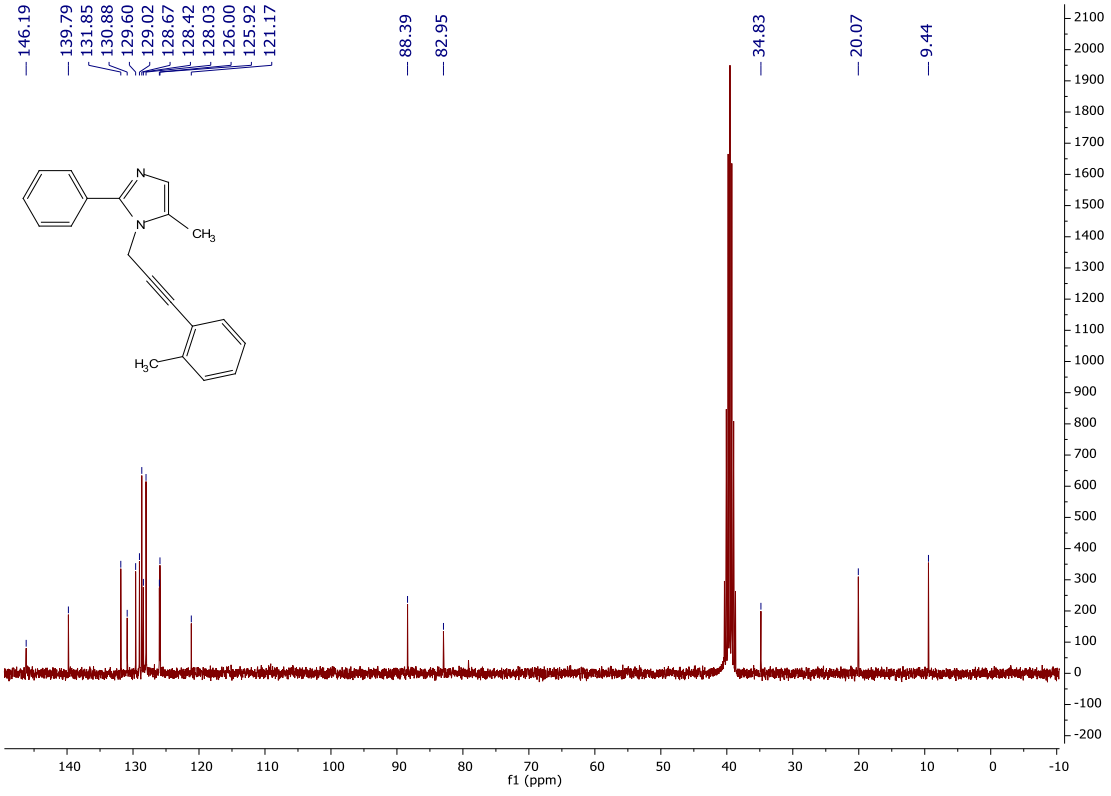
^{1}H and ^{13}C NMR spectra of compound **1b**



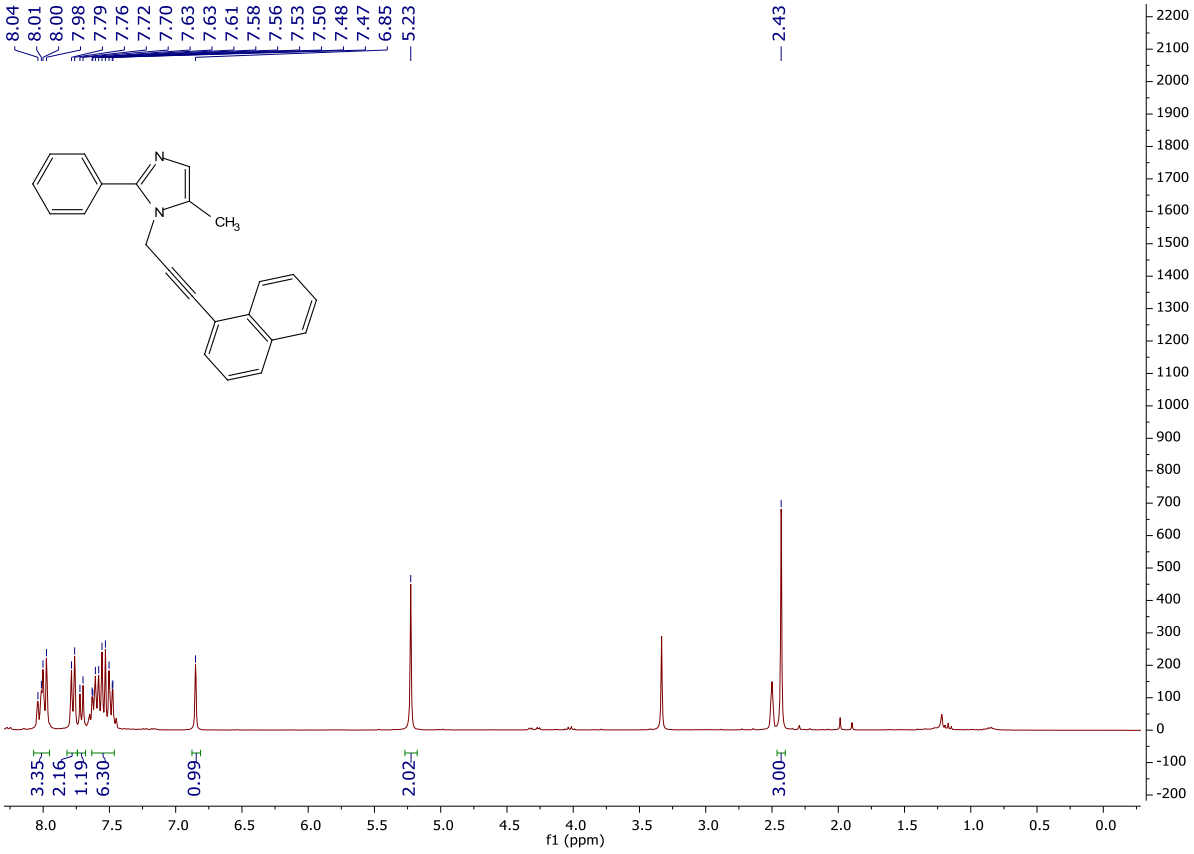


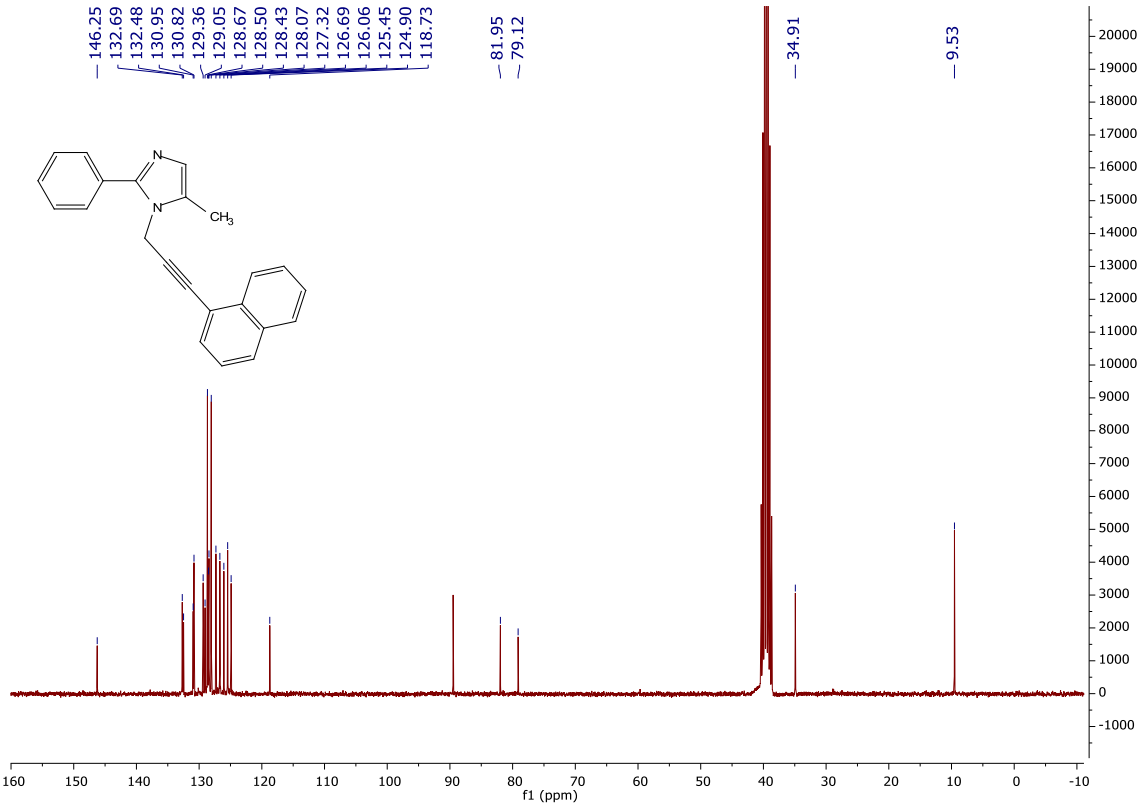
^{1}H and ^{13}C NMR spectra of compound **1c**



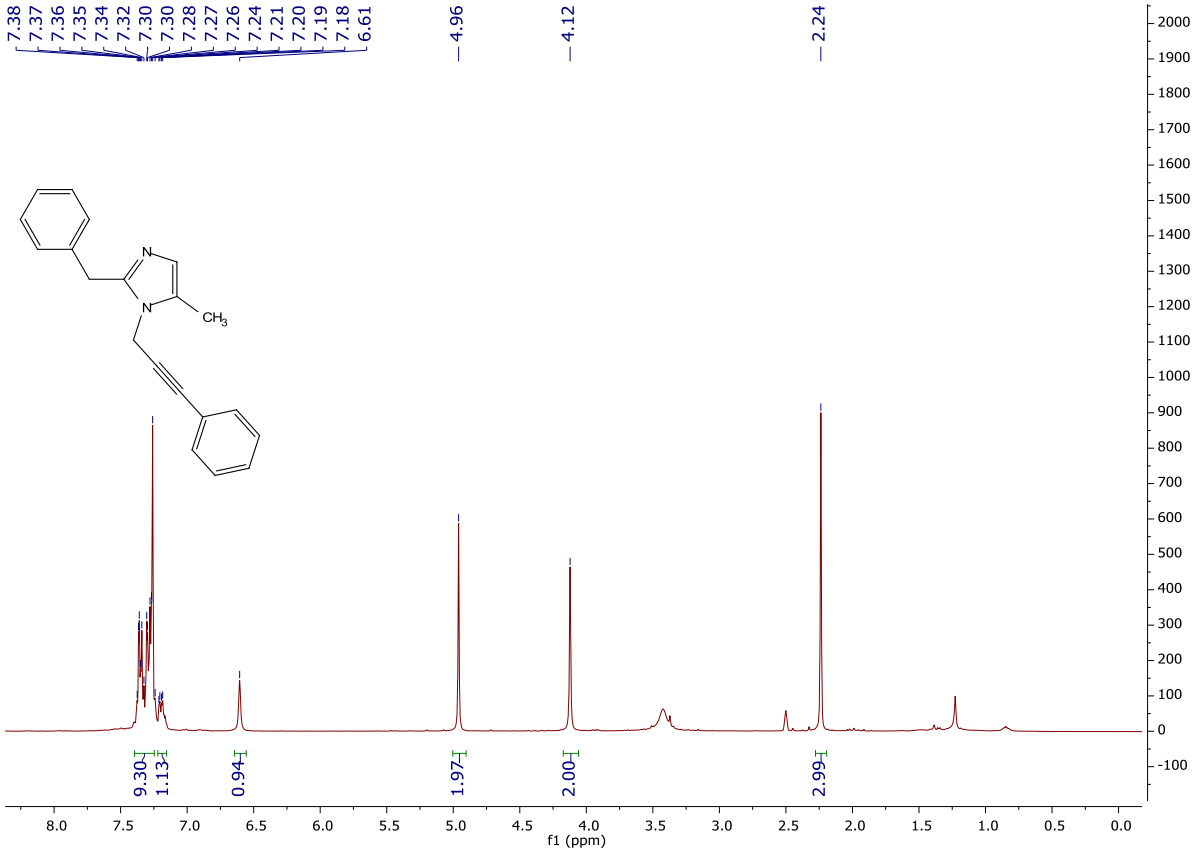


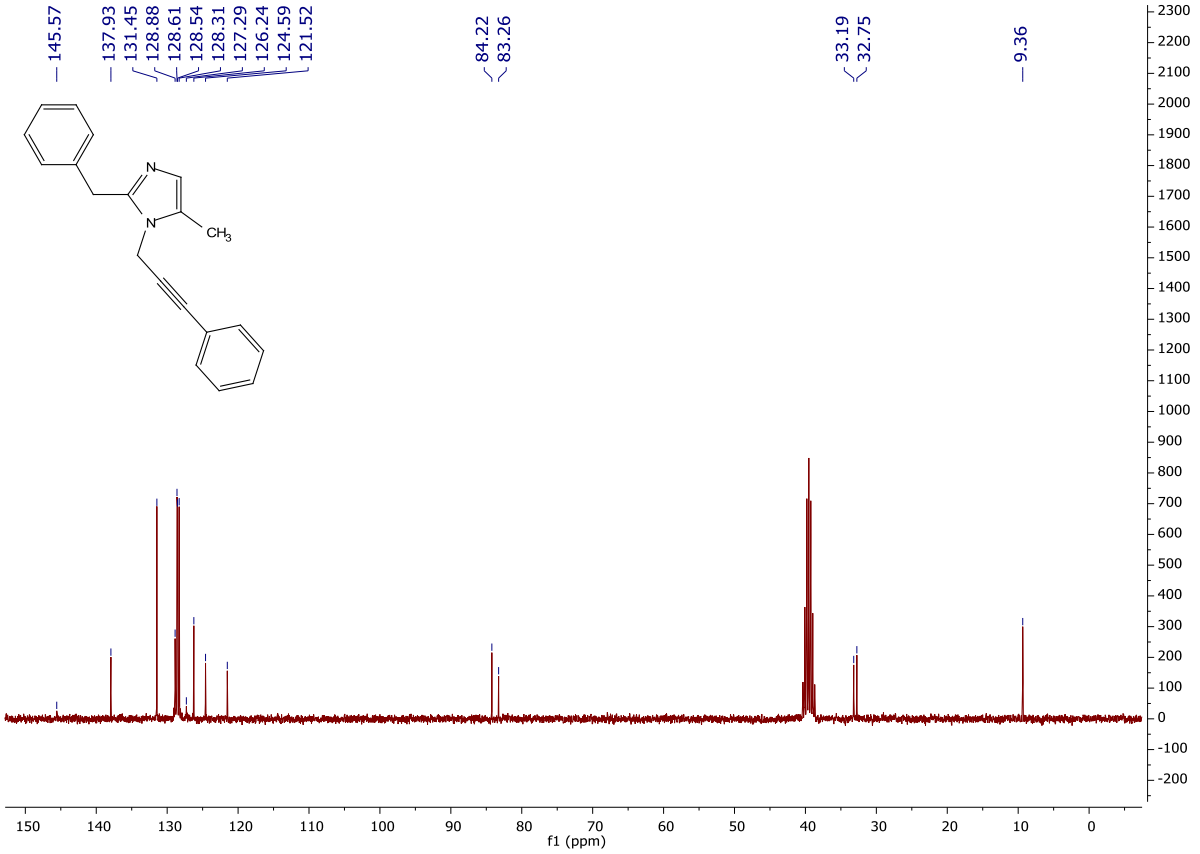
^{1}H and ^{13}C NMR spectra of compound **1d**



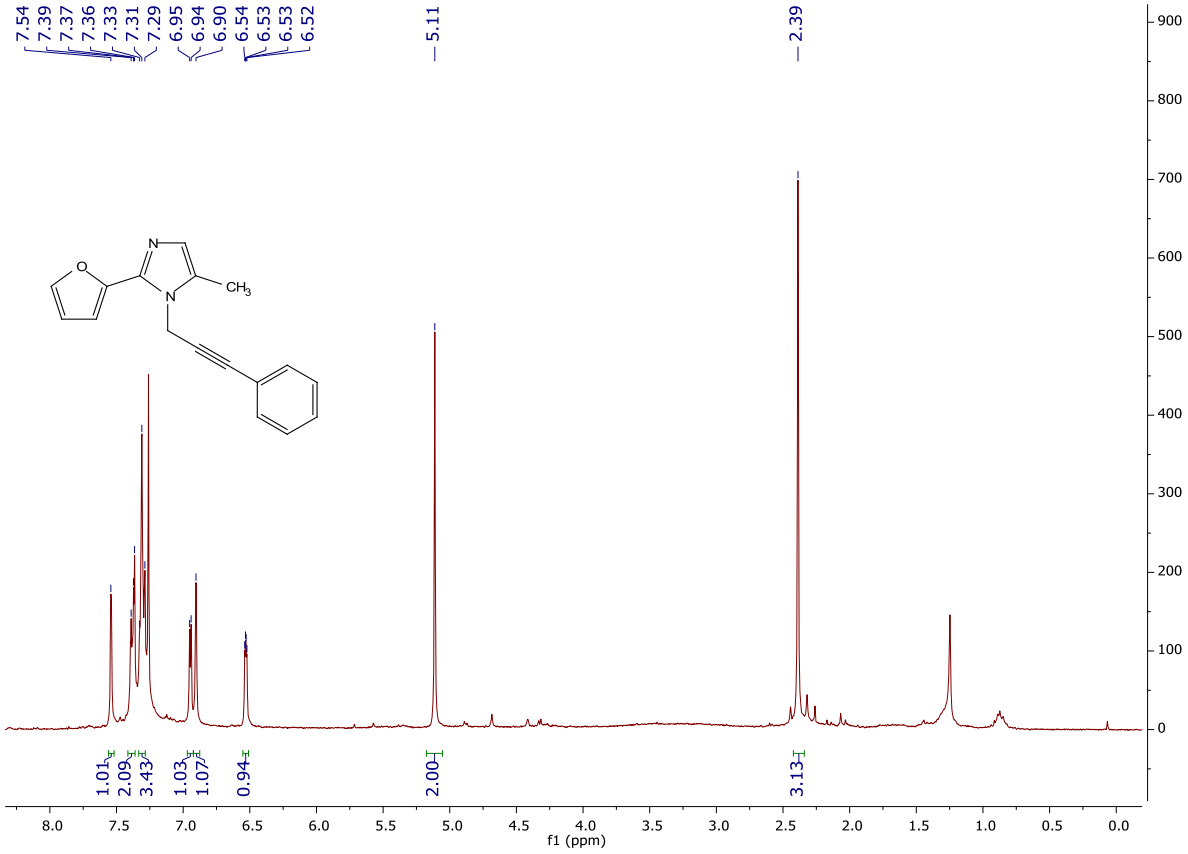


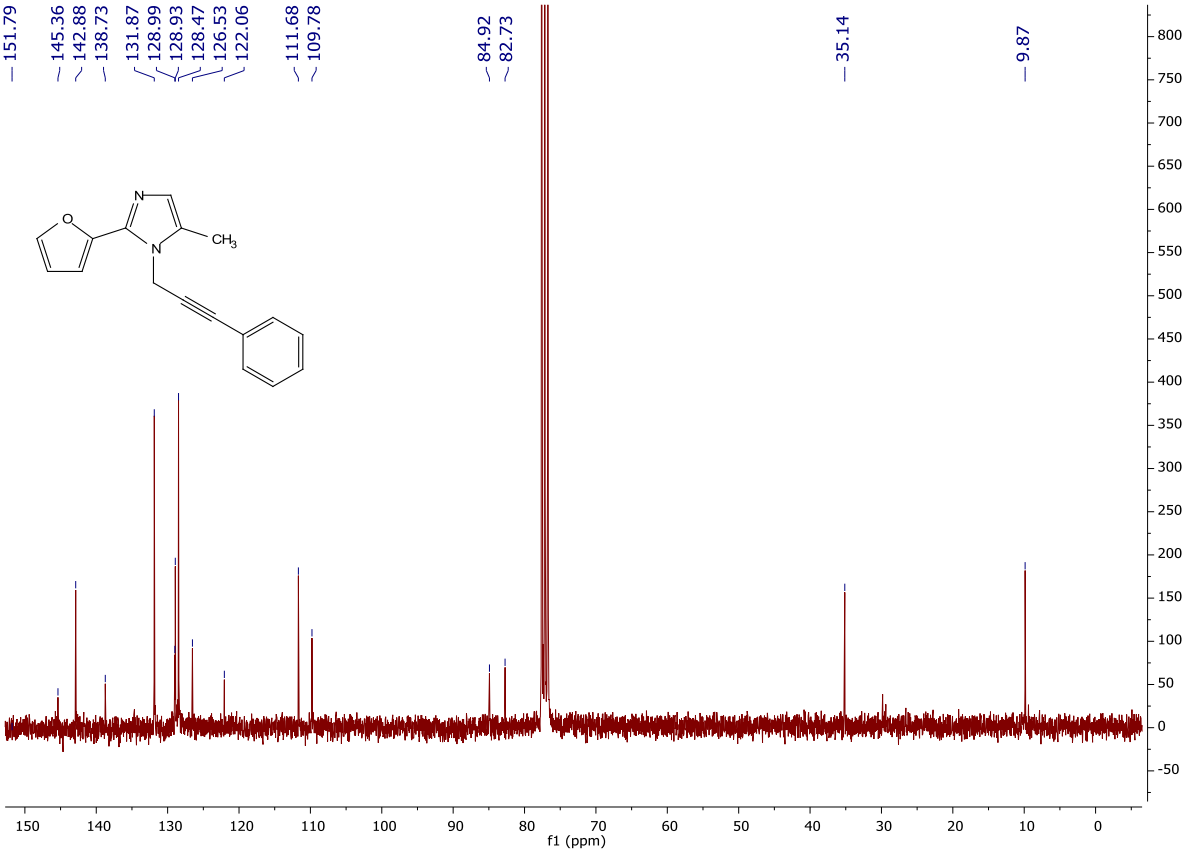
^{1}H and ^{13}C NMR spectra of compound **1e**



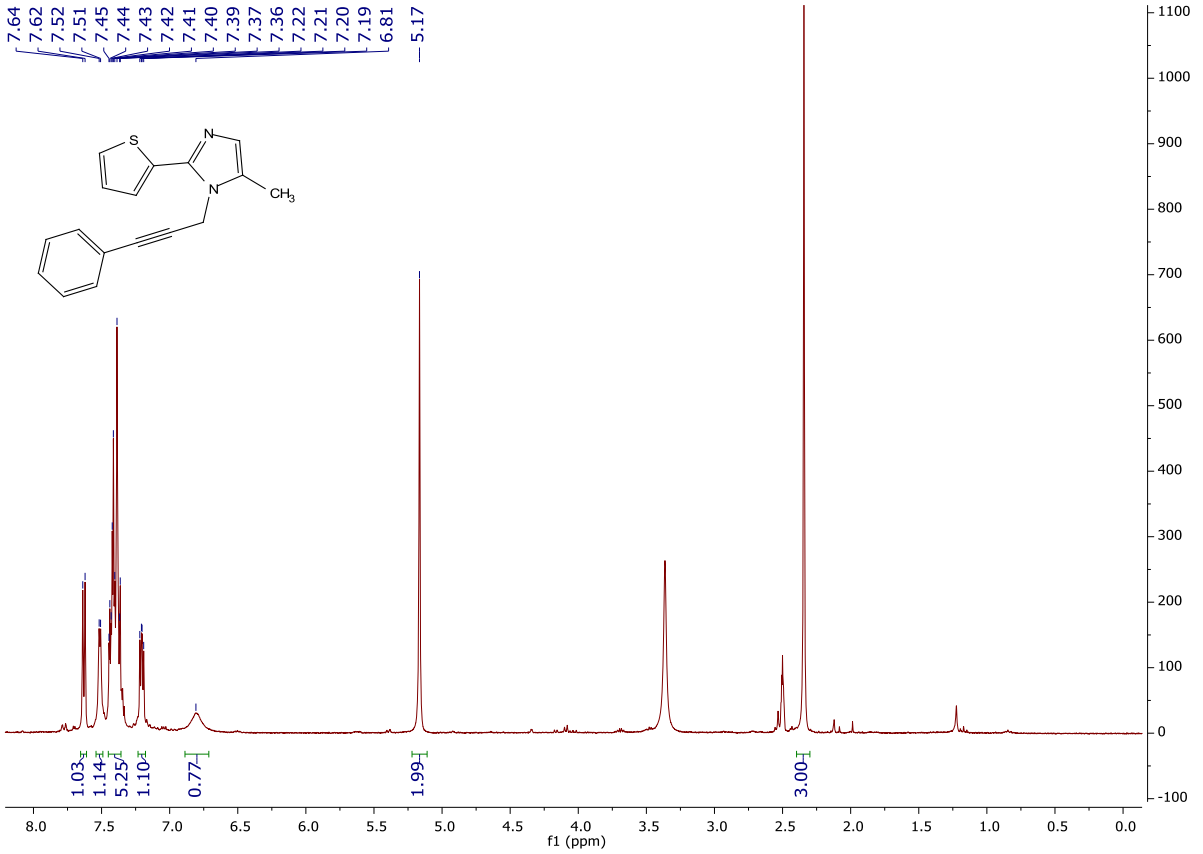


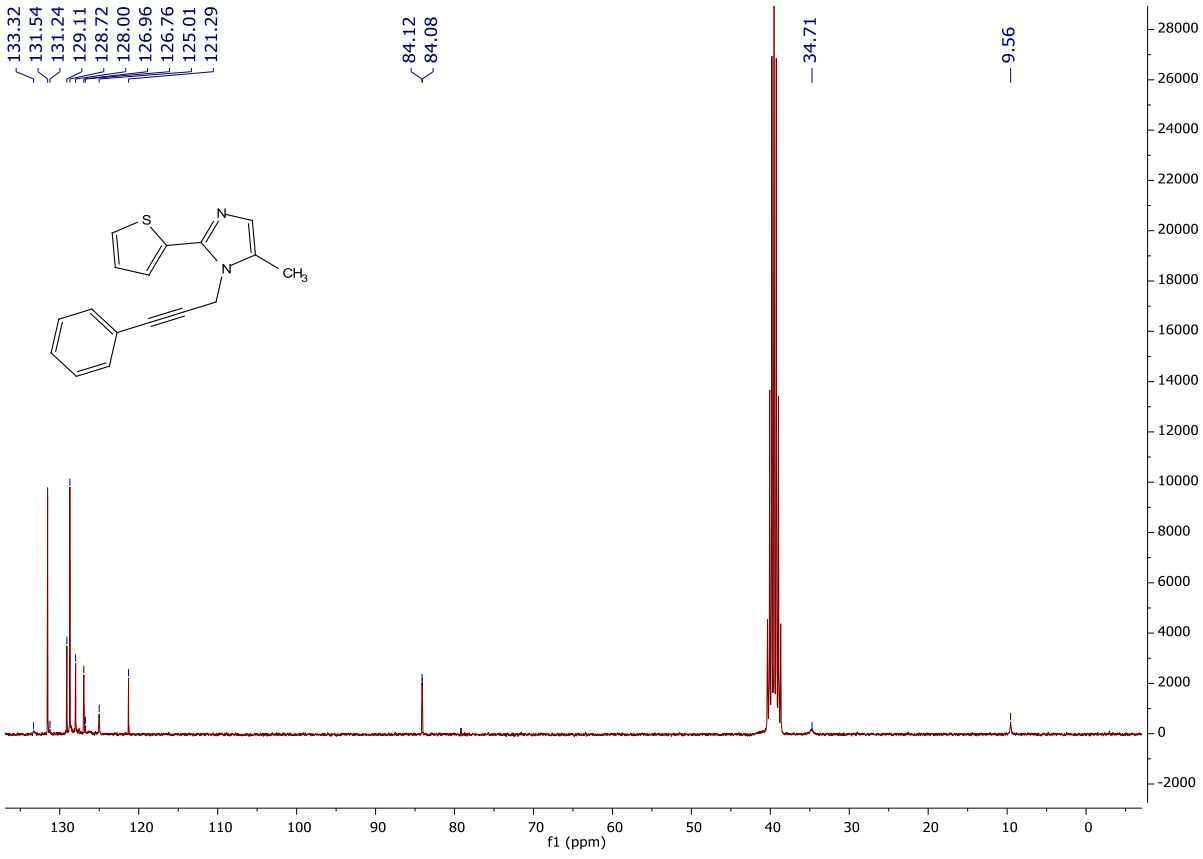
^{1}H and ^{13}C NMR spectra of compound **1f**



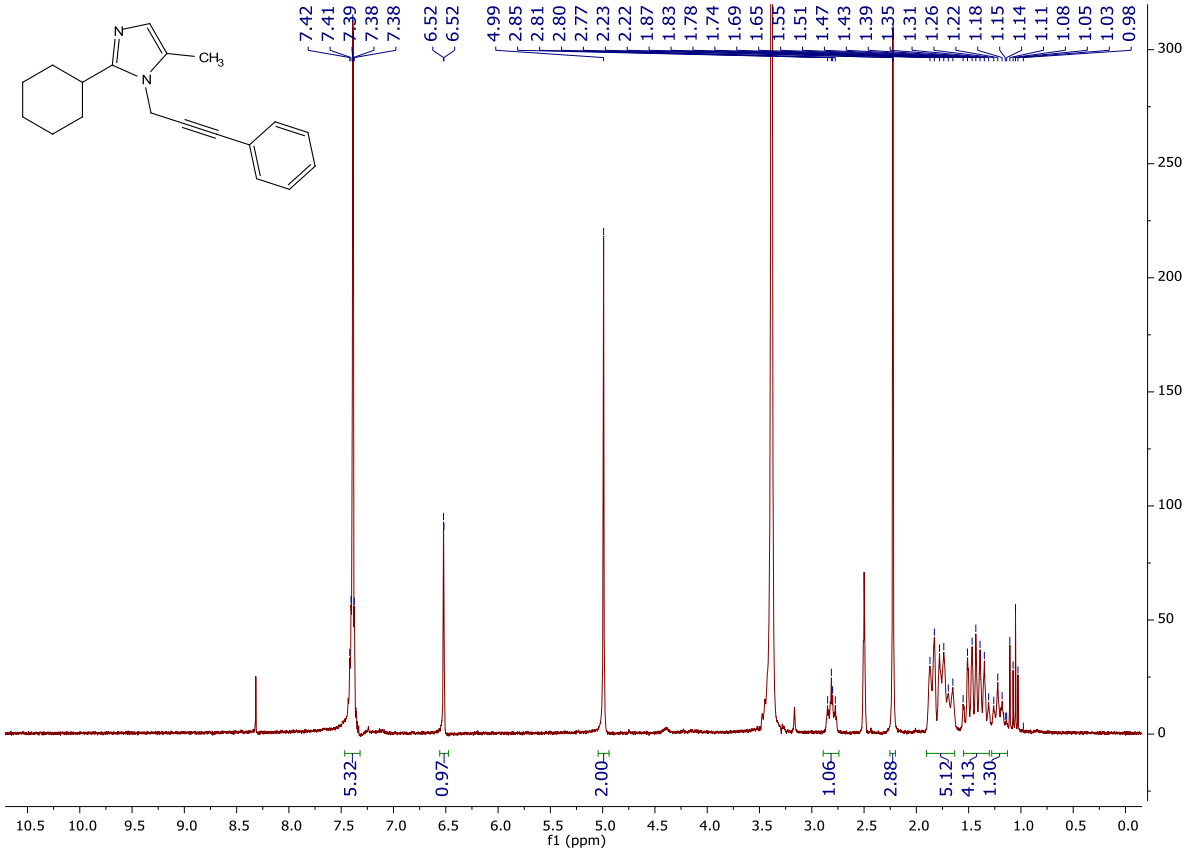


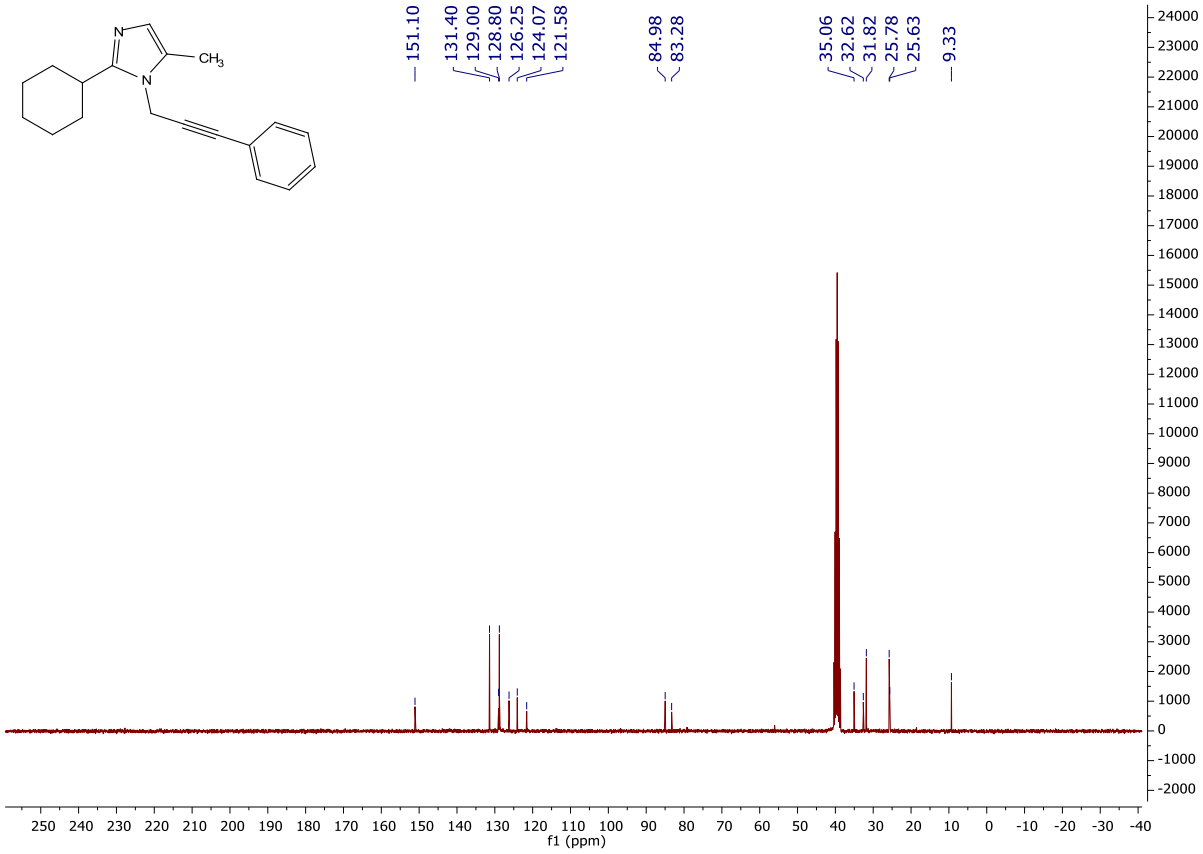
^{1}H and ^{13}C NMR spectra of compound **1g**



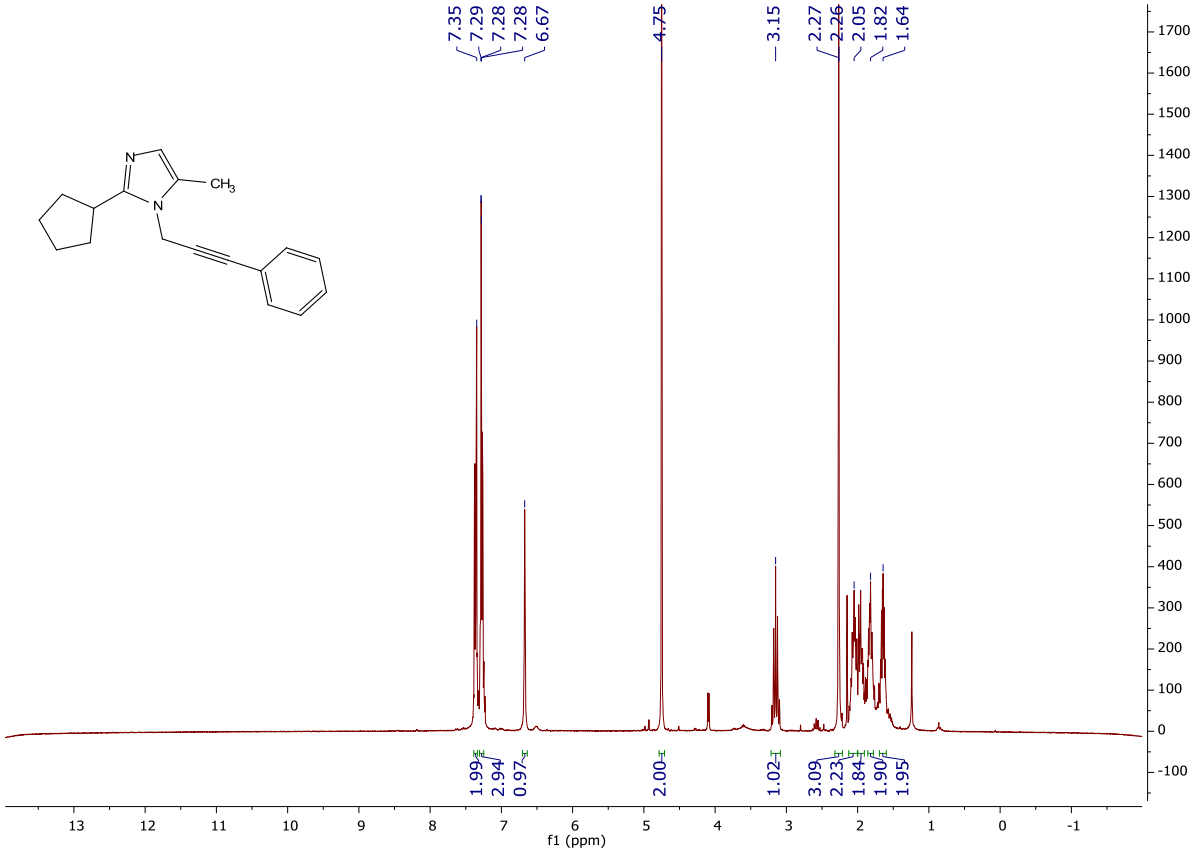


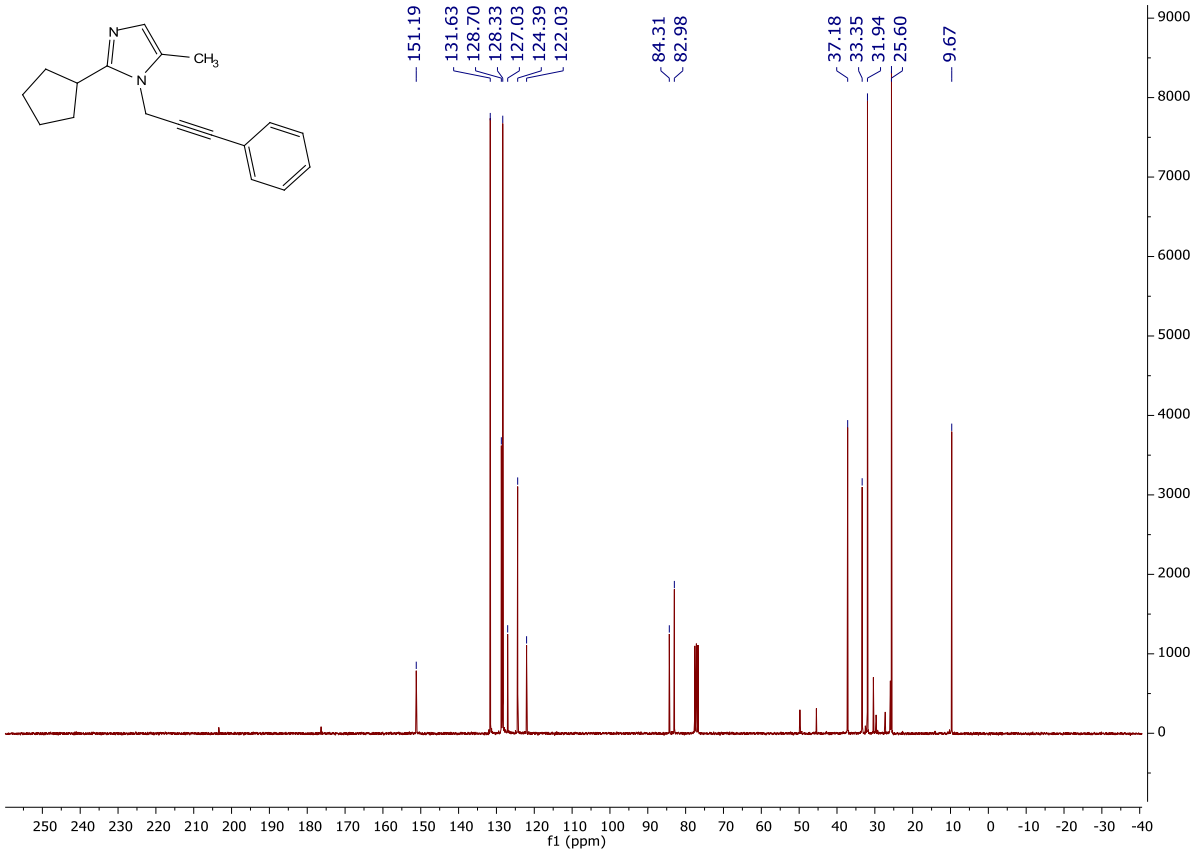
^{1}H and ^{13}C NMR spectra of compound **1h**



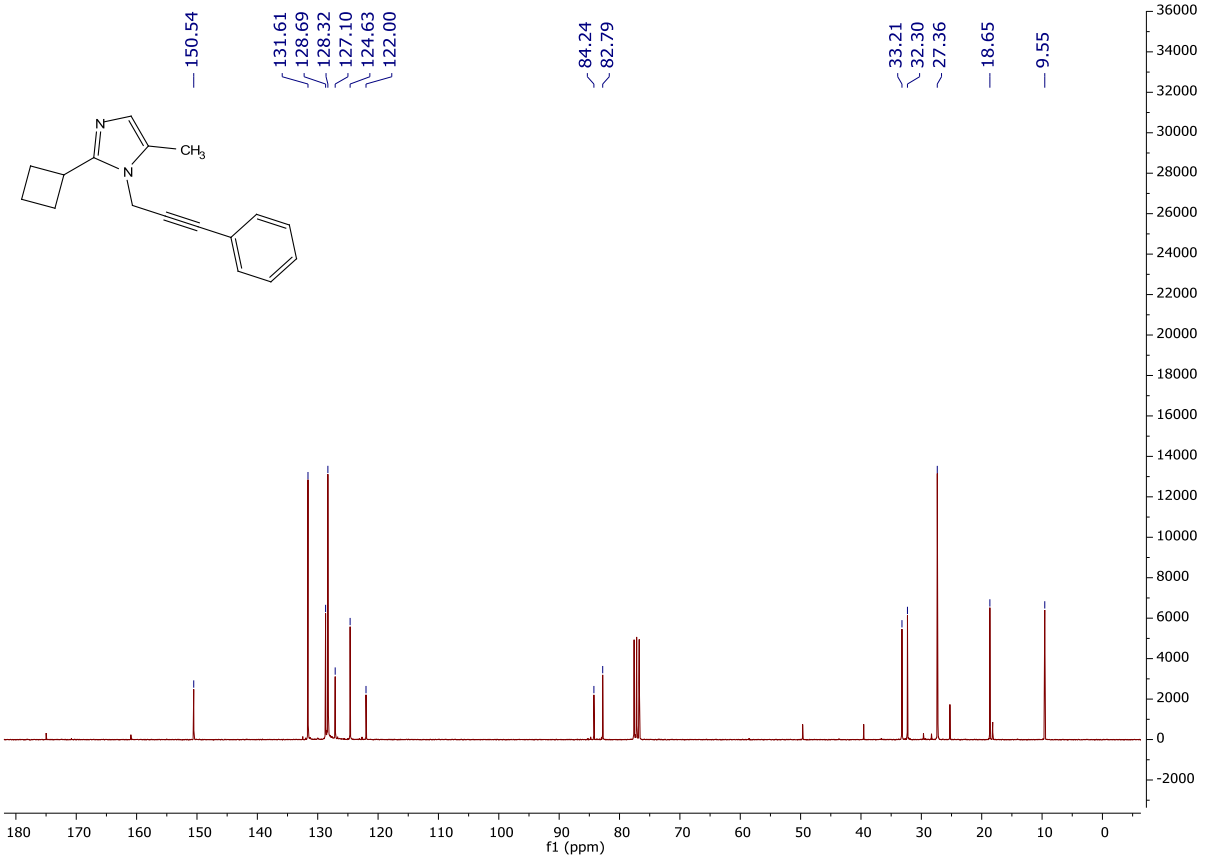


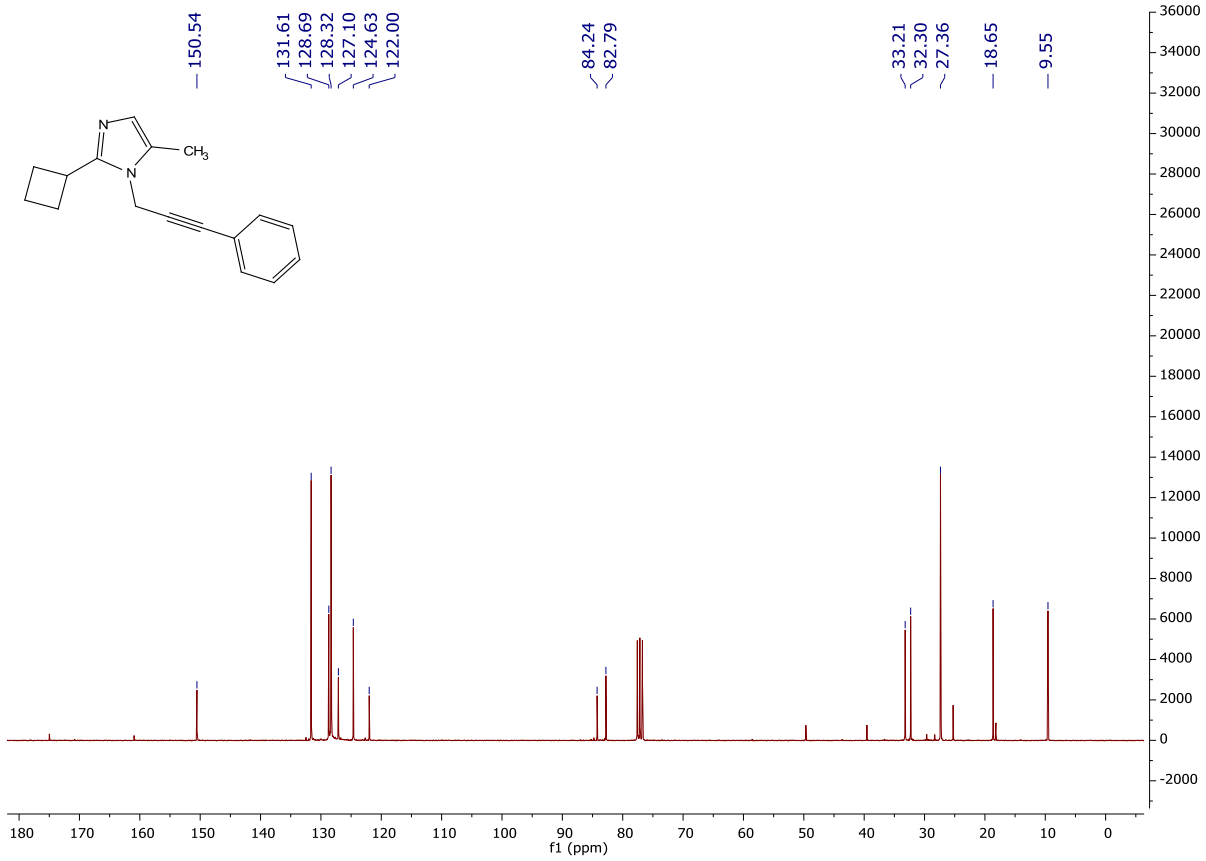
^{1}H and ^{13}C NMR spectra of compound **1i**



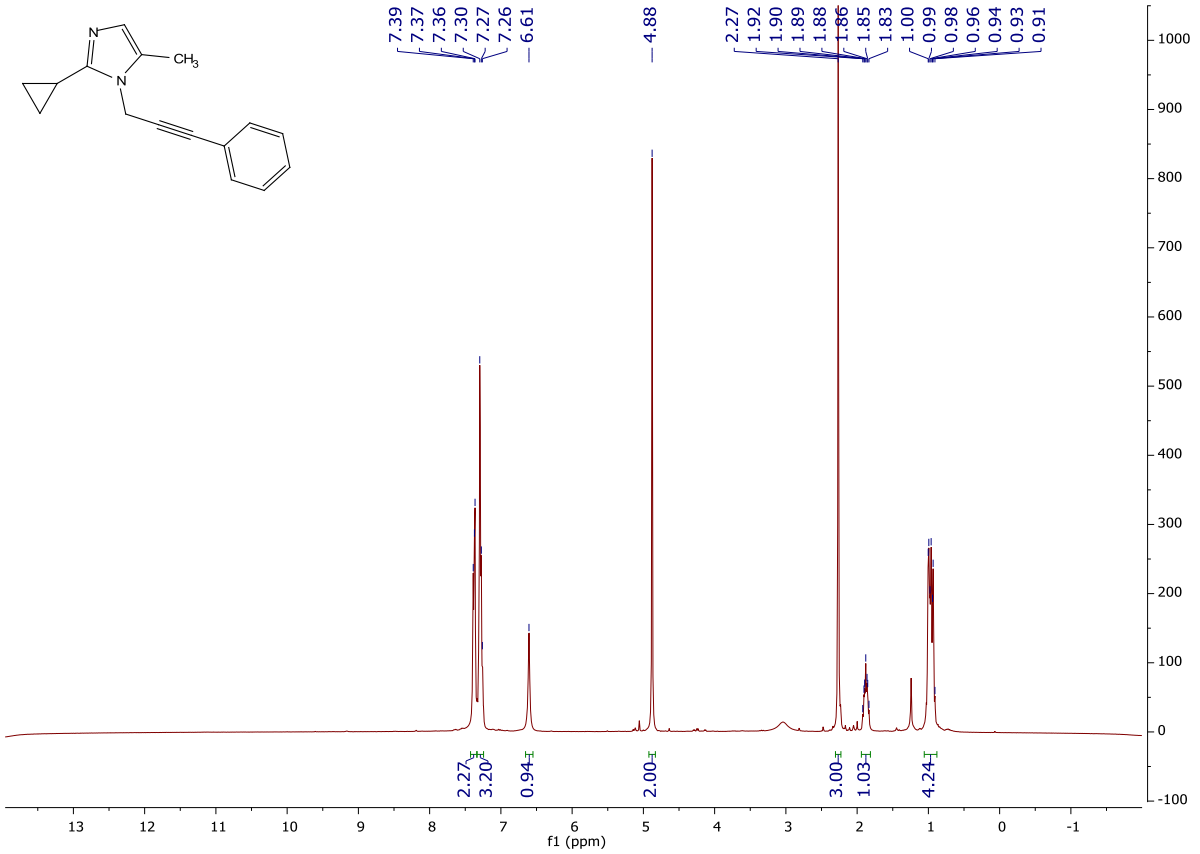


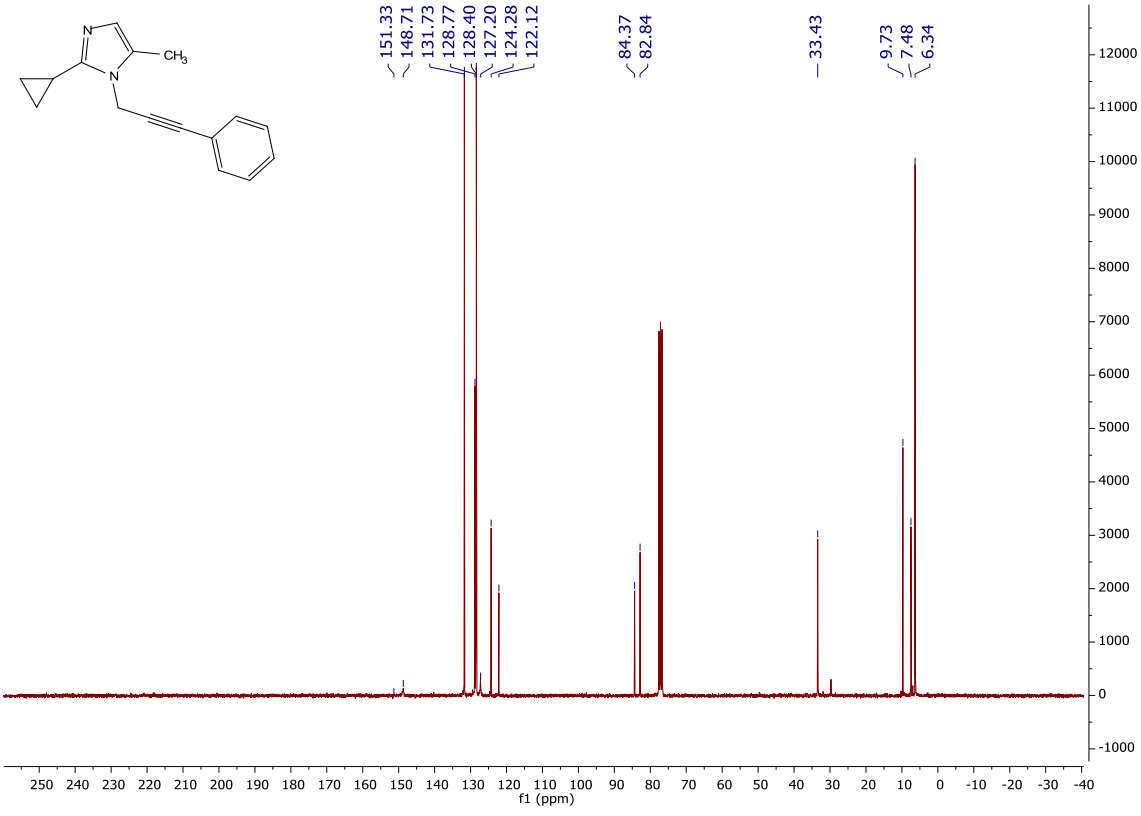
^{1}H and ^{13}C NMR spectra of compound **1j**



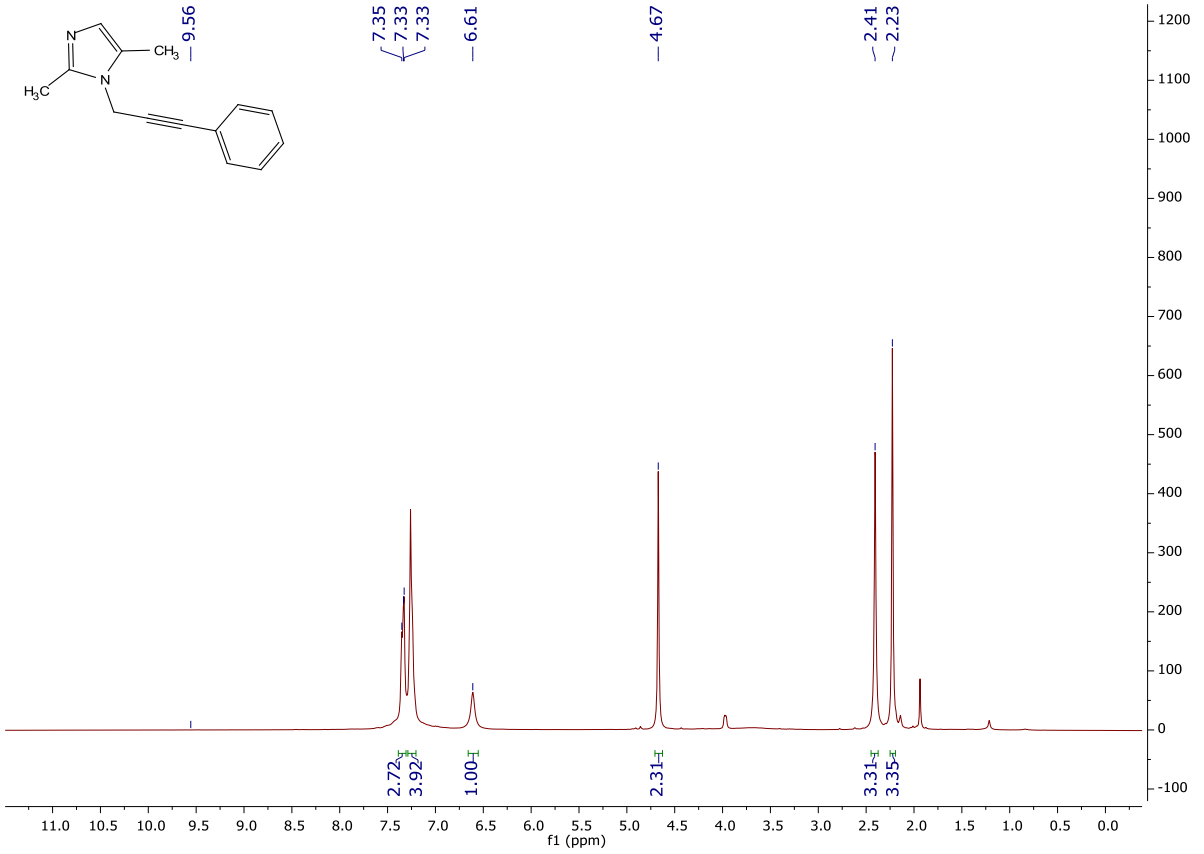


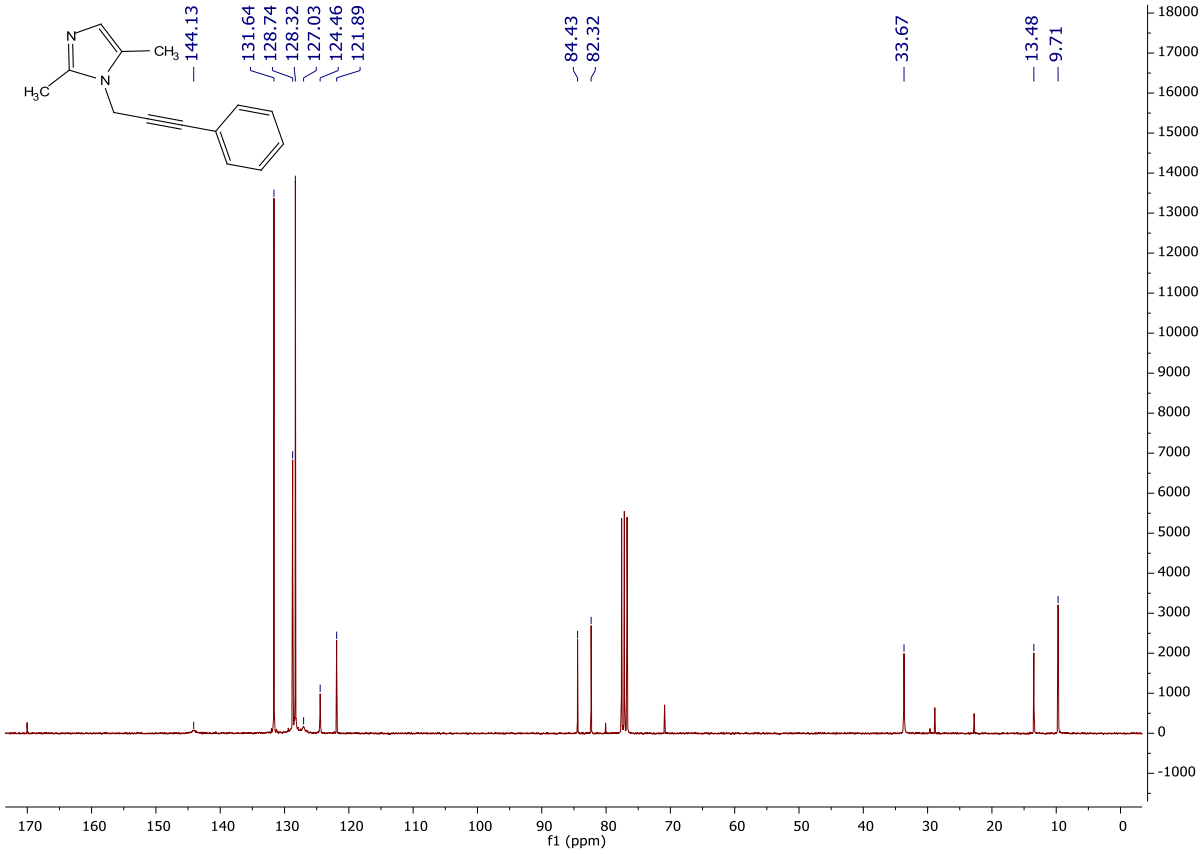
^{1}H and ^{13}C NMR spectra of compound **1k**



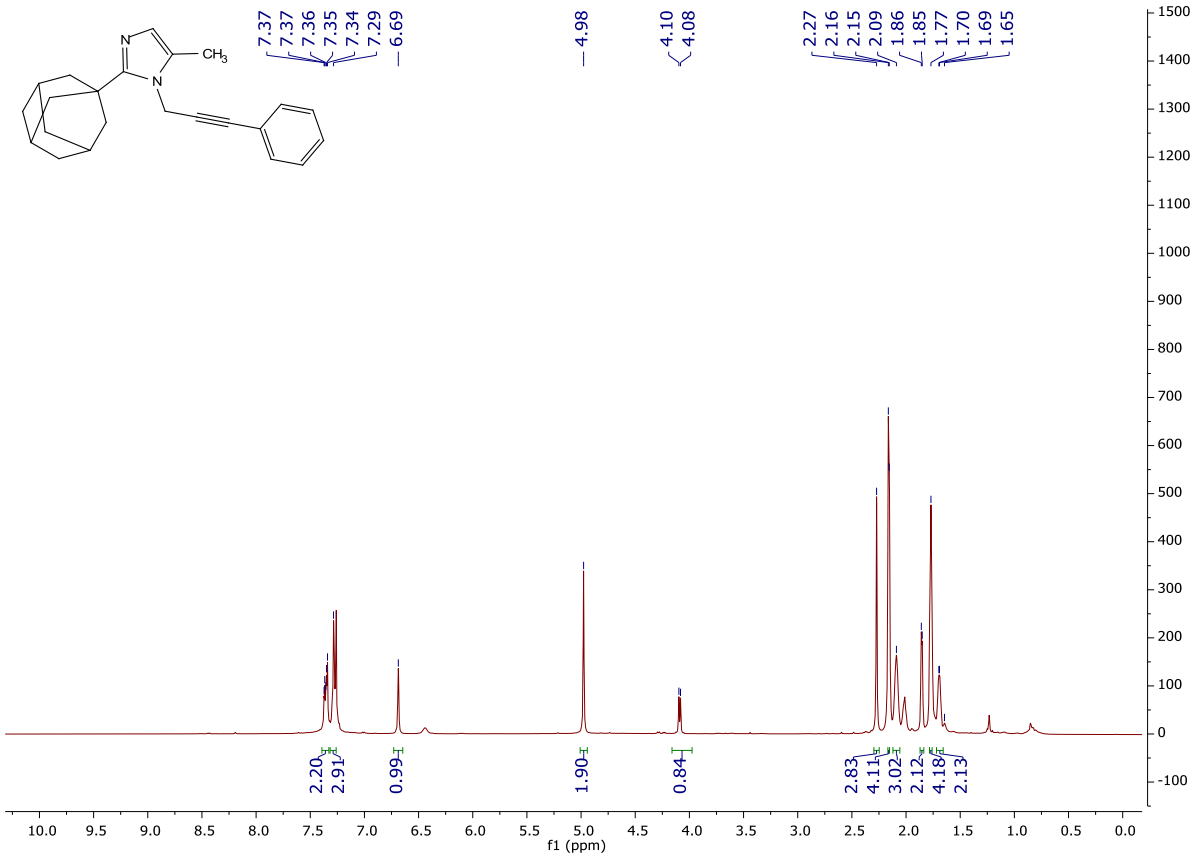


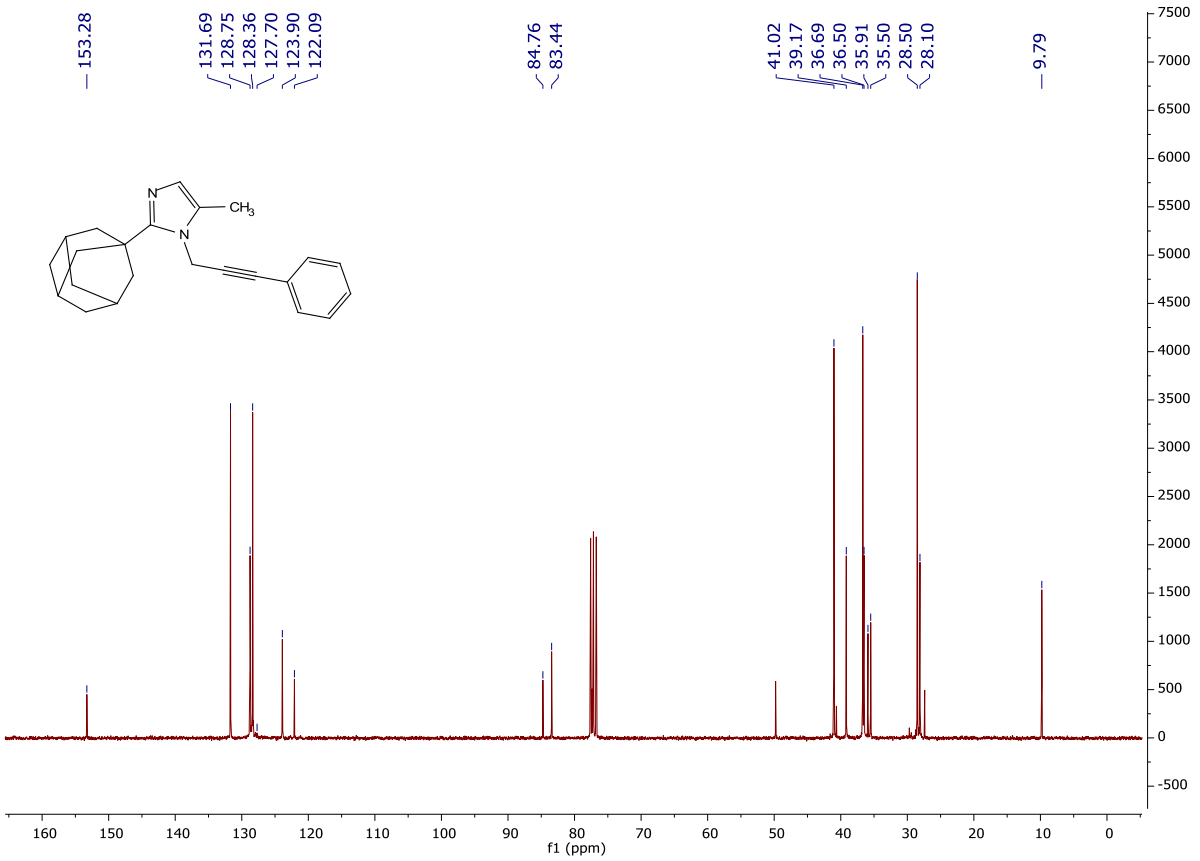
^{1}H and ^{13}C NMR spectra of compound **1l**



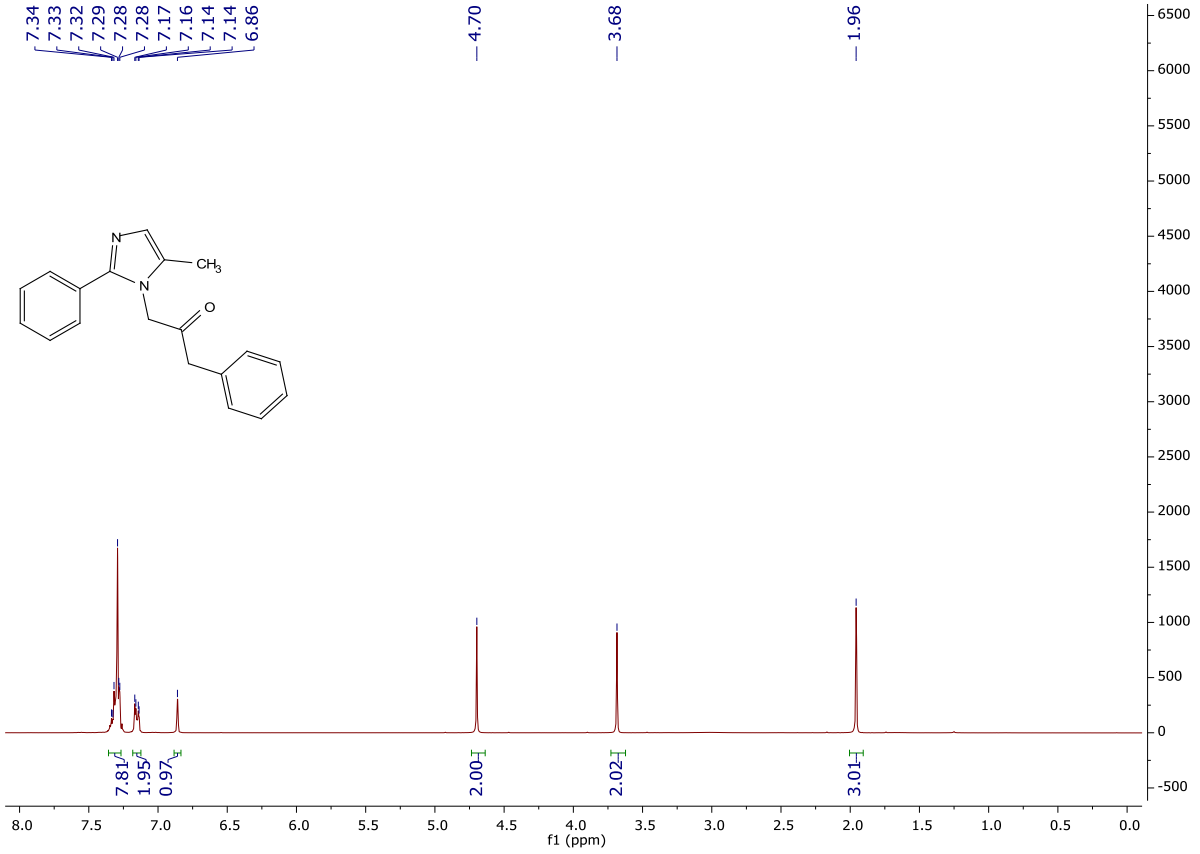


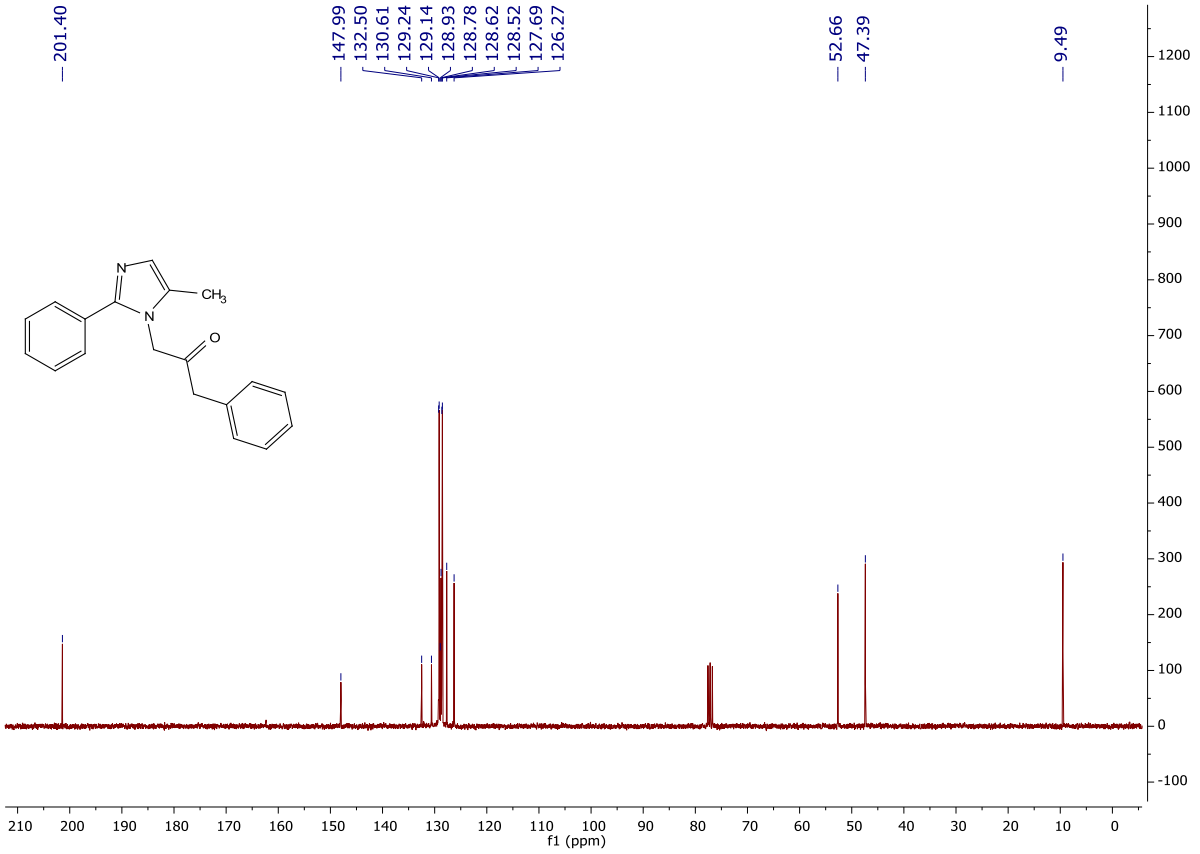
^{1}H and ^{13}C NMR spectra of compound **1m**



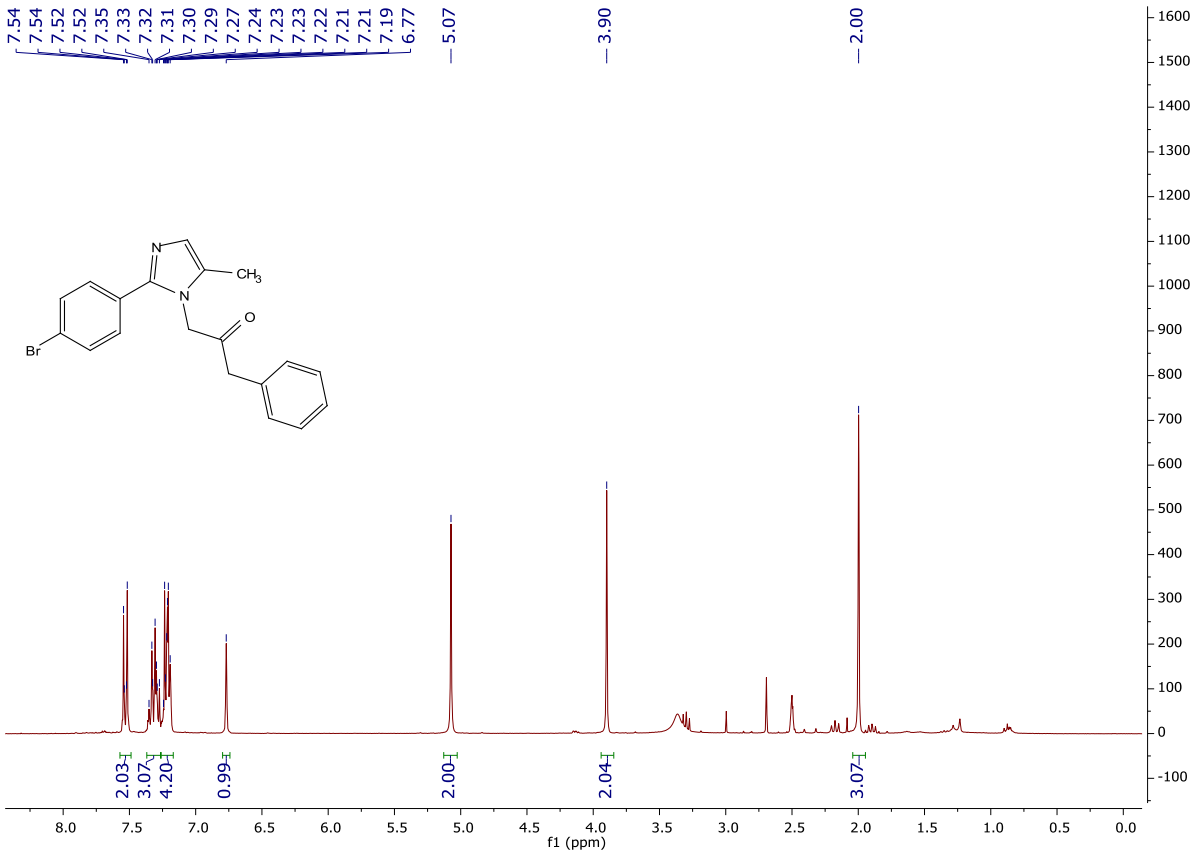


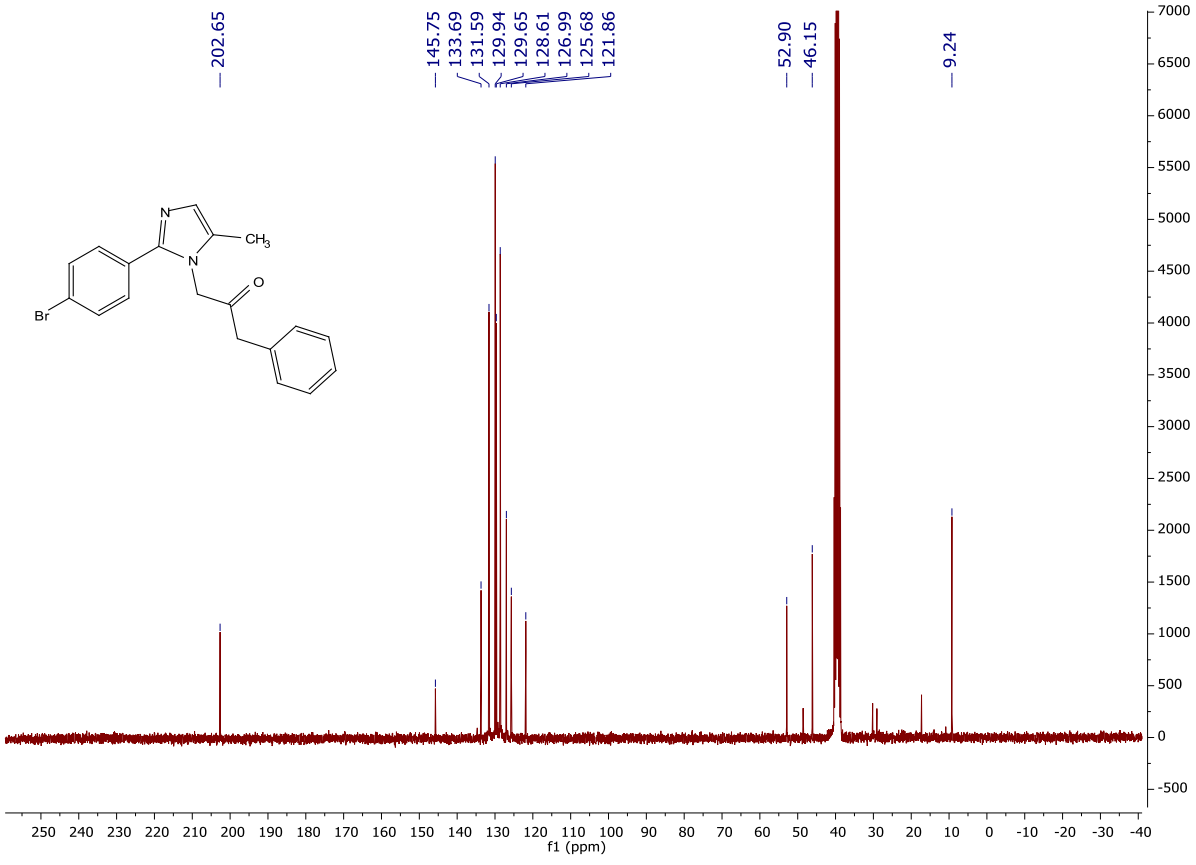
^{1}H and ^{13}C NMR spectra of compound **4a**



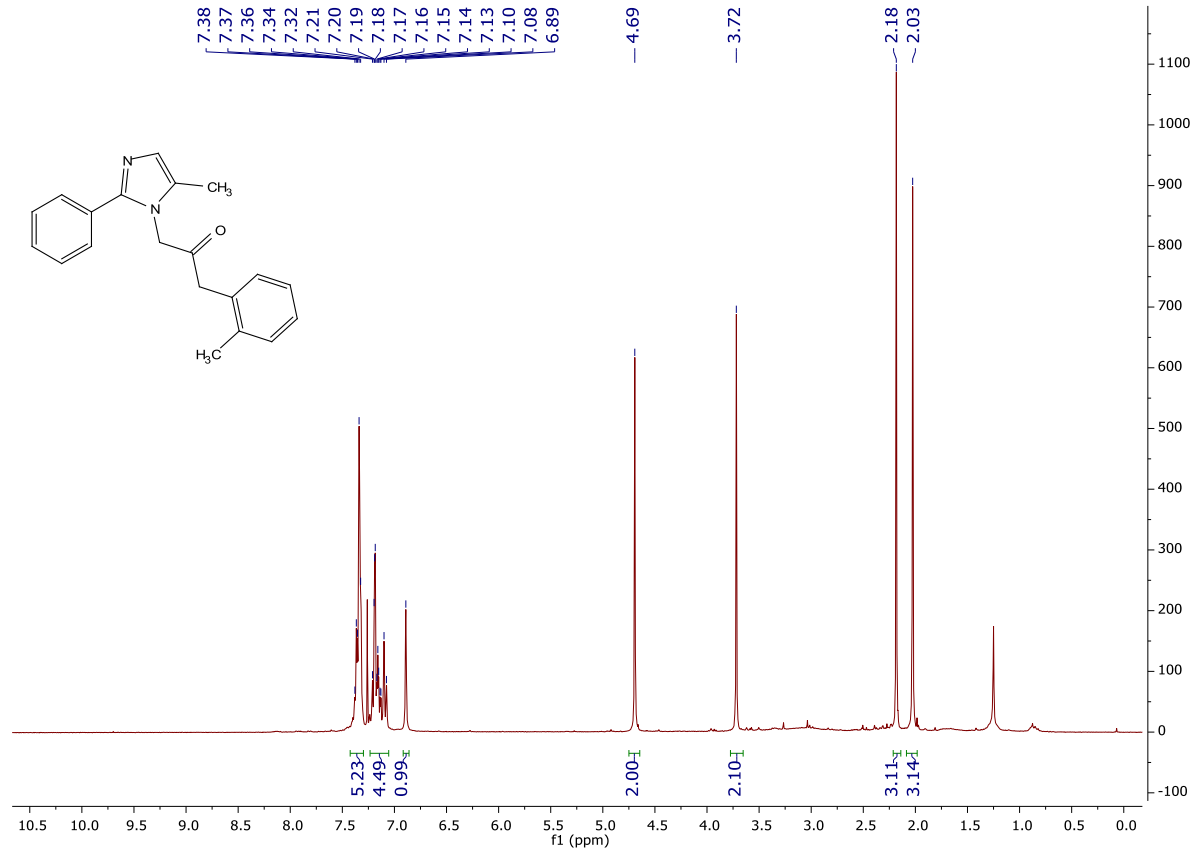


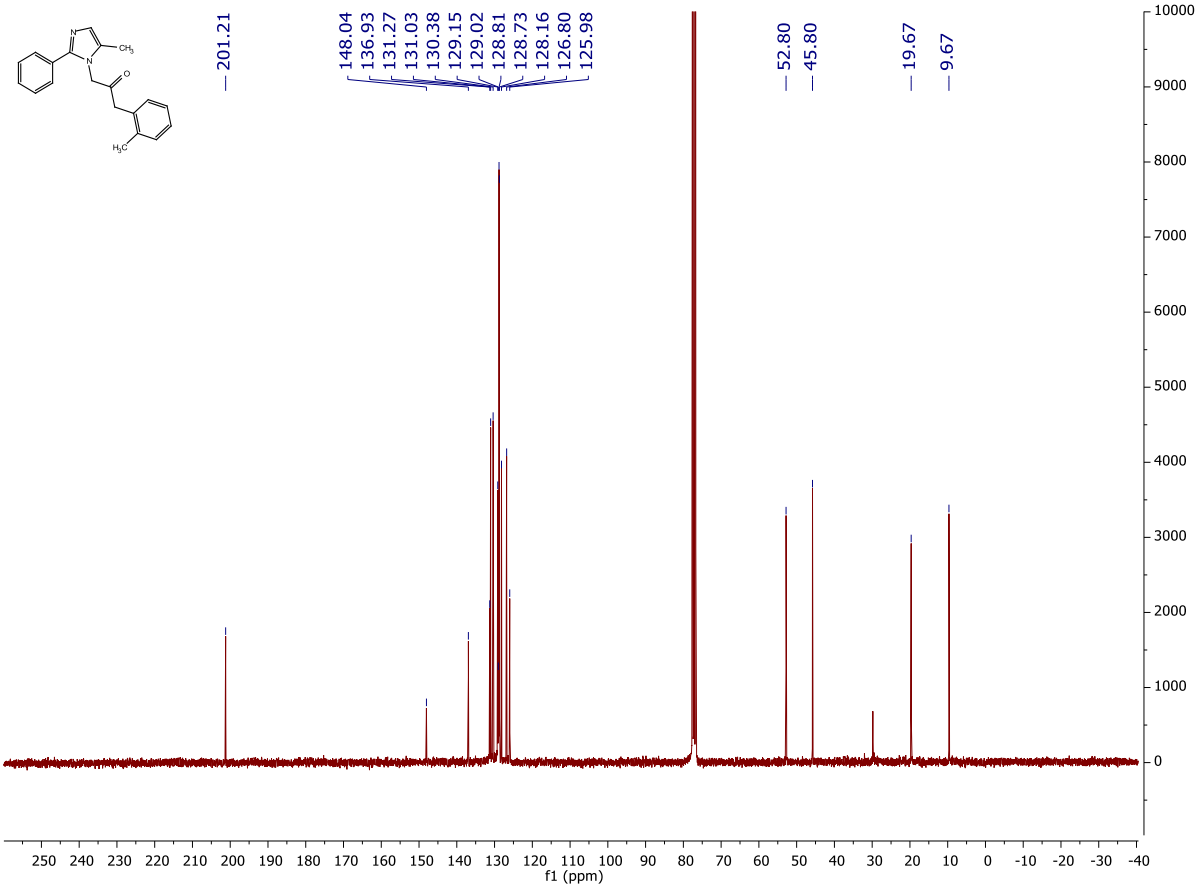
^{1}H and ^{13}C NMR spectra of compound **4b**



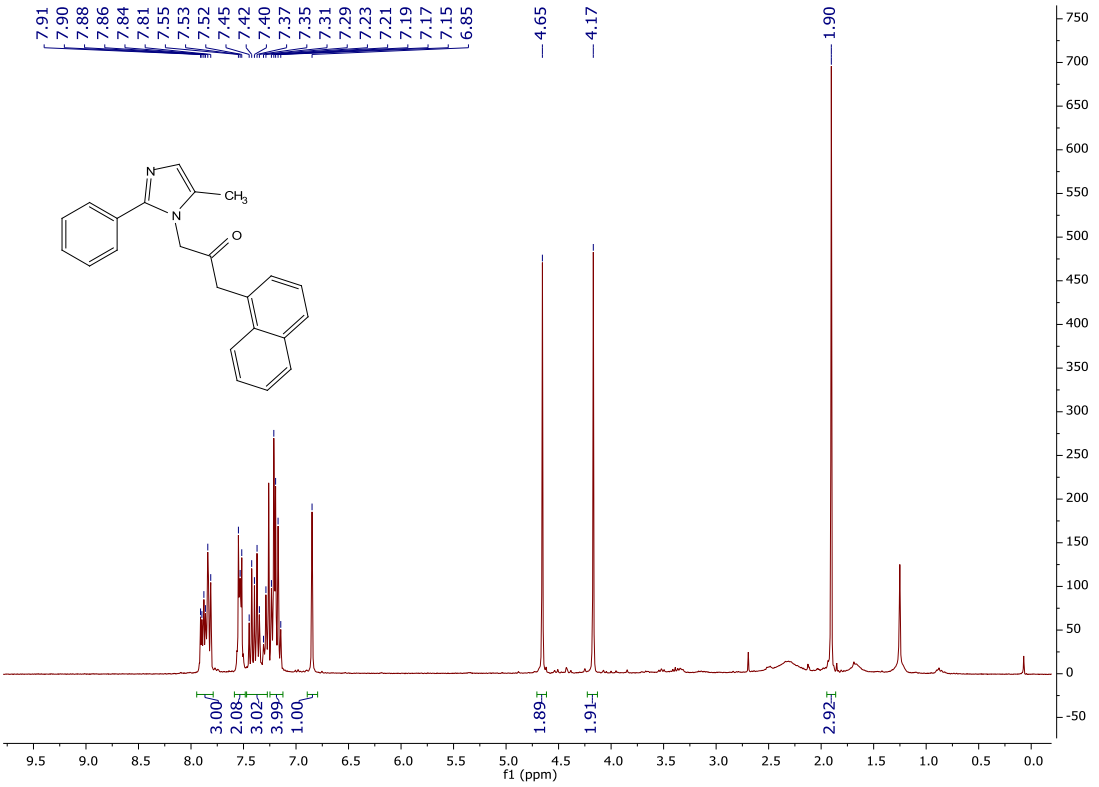


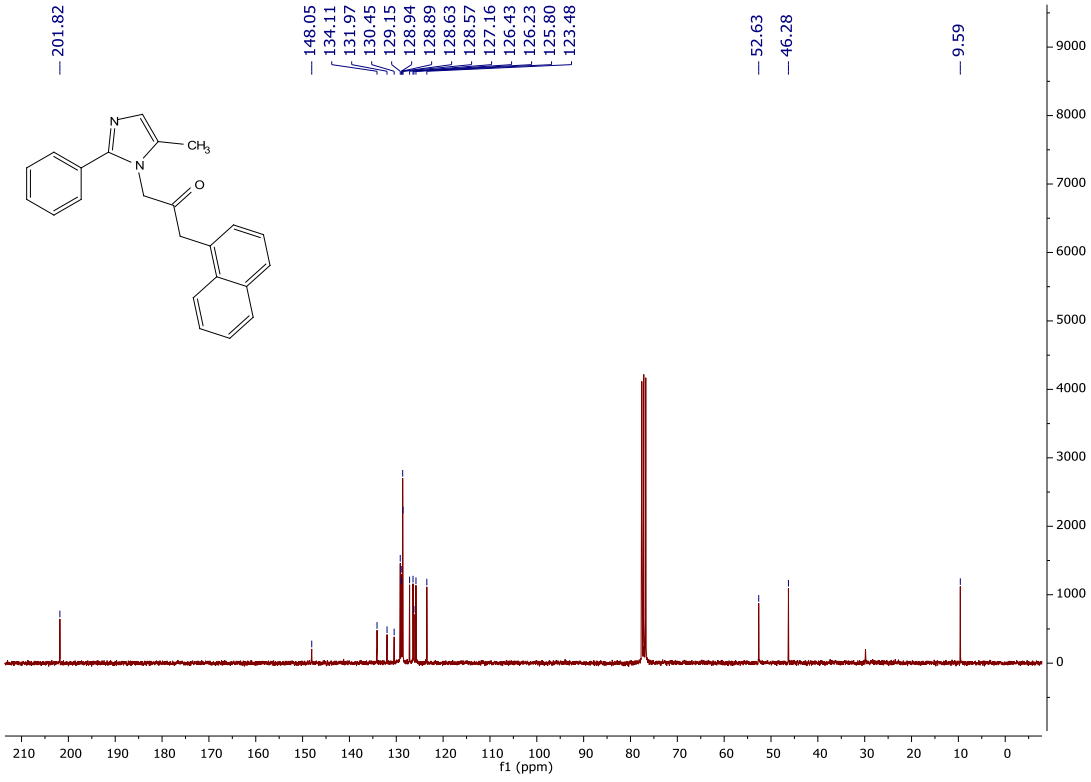
^{1}H and ^{13}C NMR spectra of compound **4c**



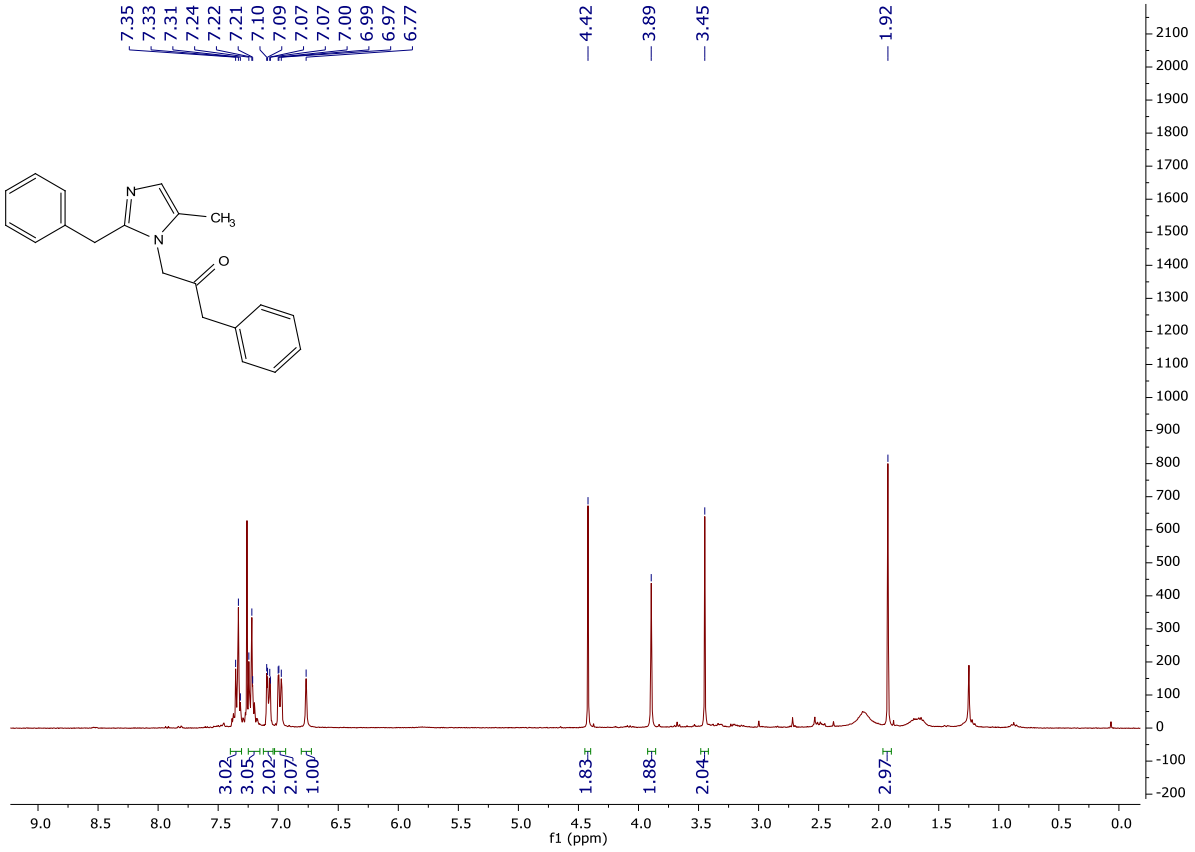


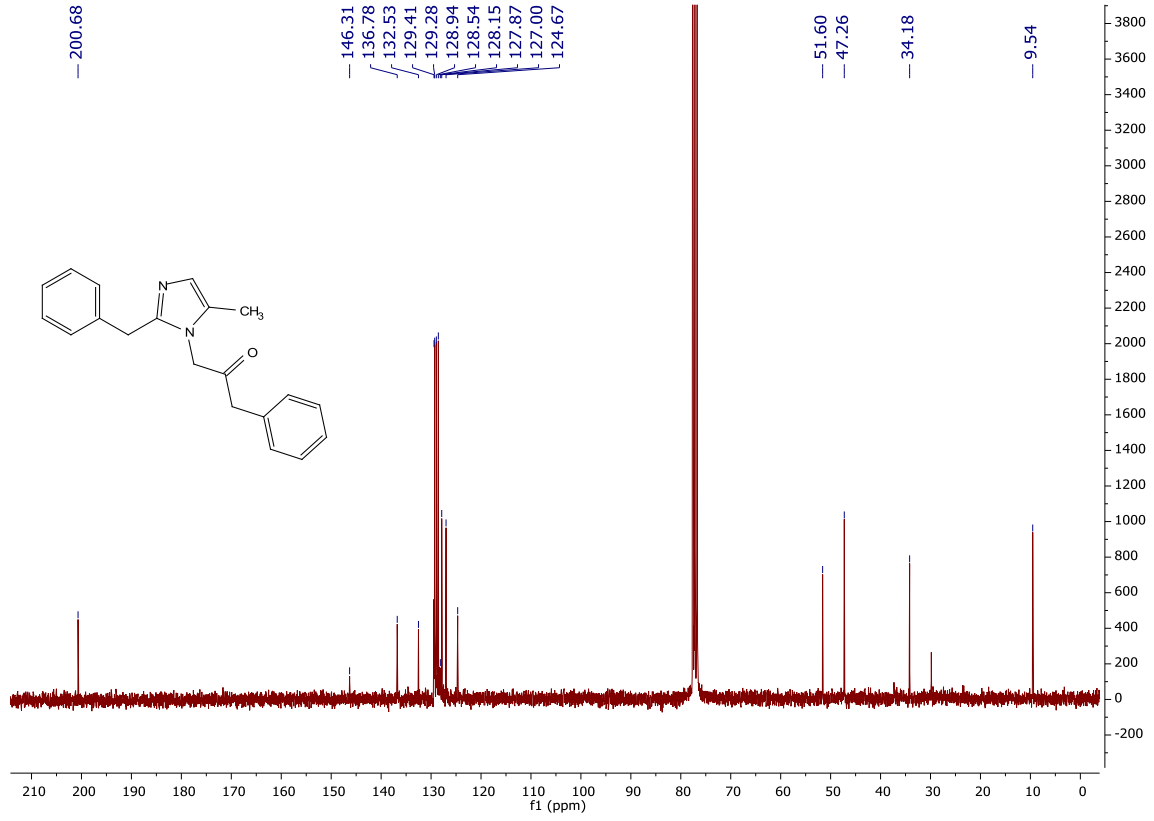
^{1}H and ^{13}C NMR spectra of compound **4d**



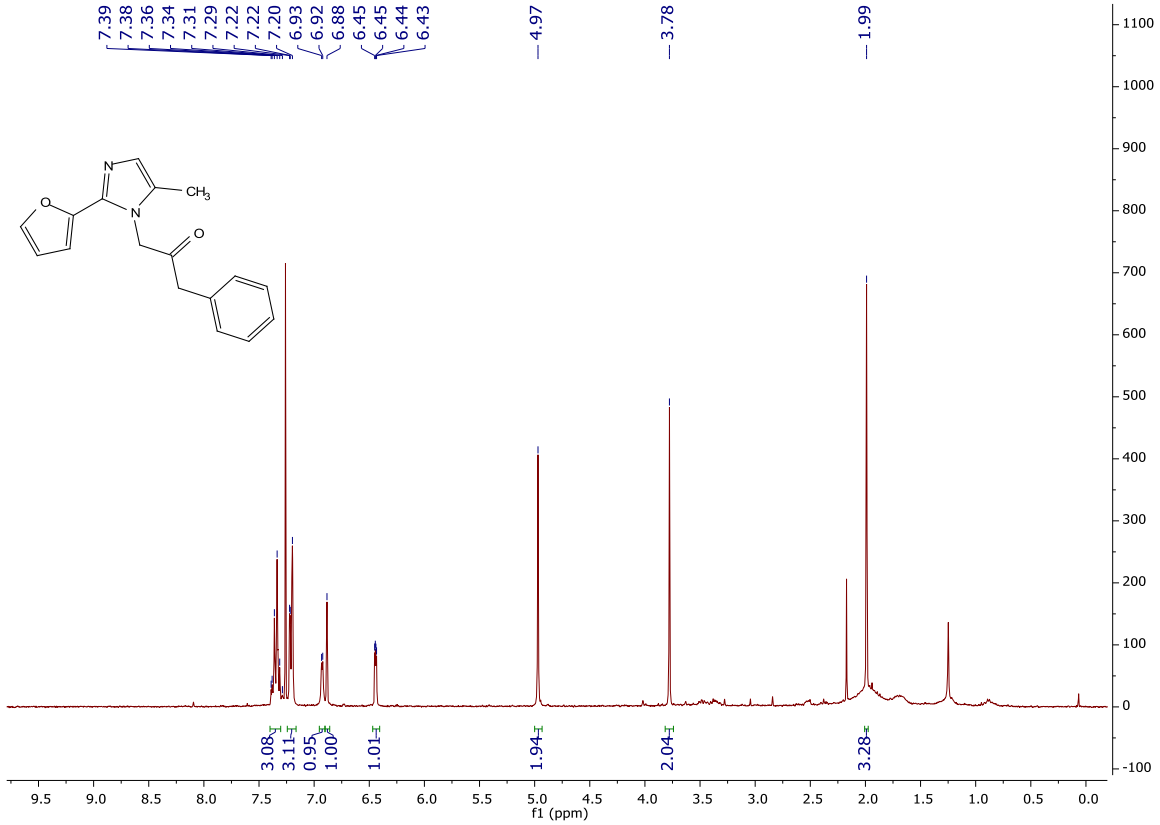


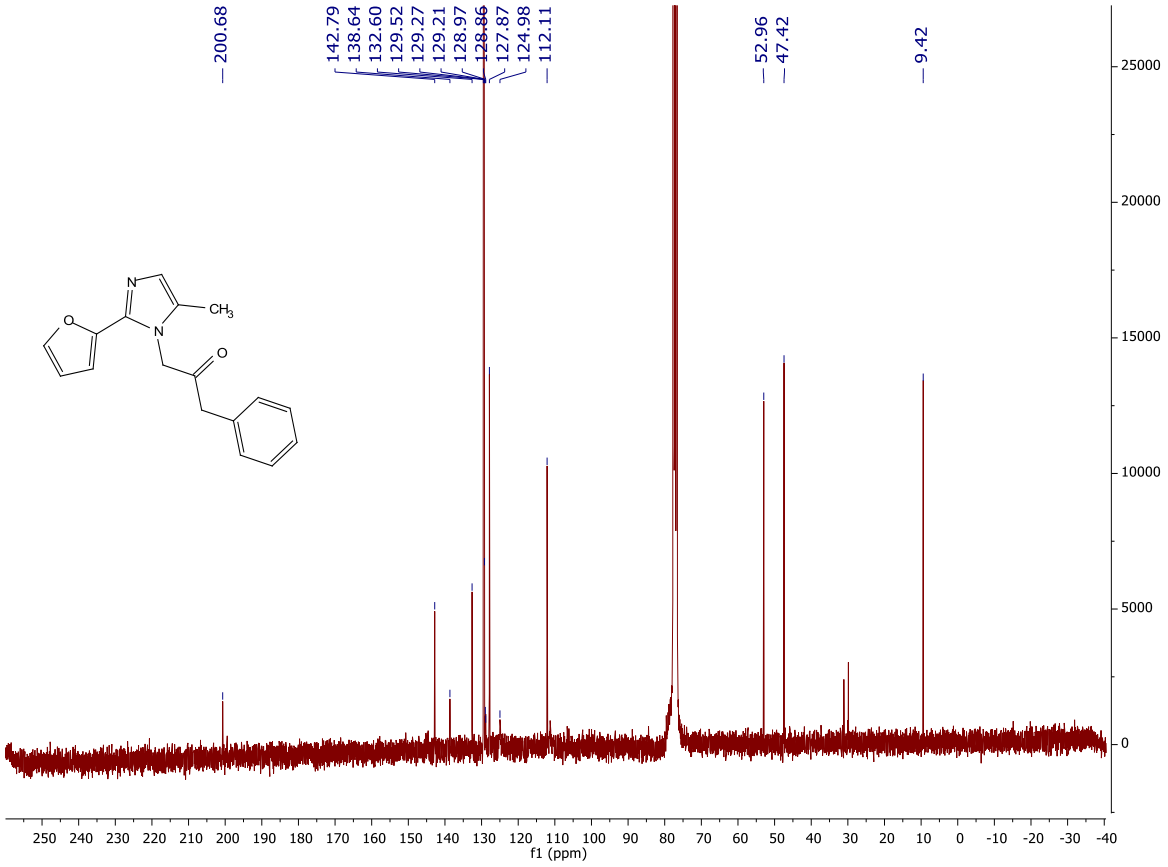
^{1}H and ^{13}C NMR spectra of compound **4e**



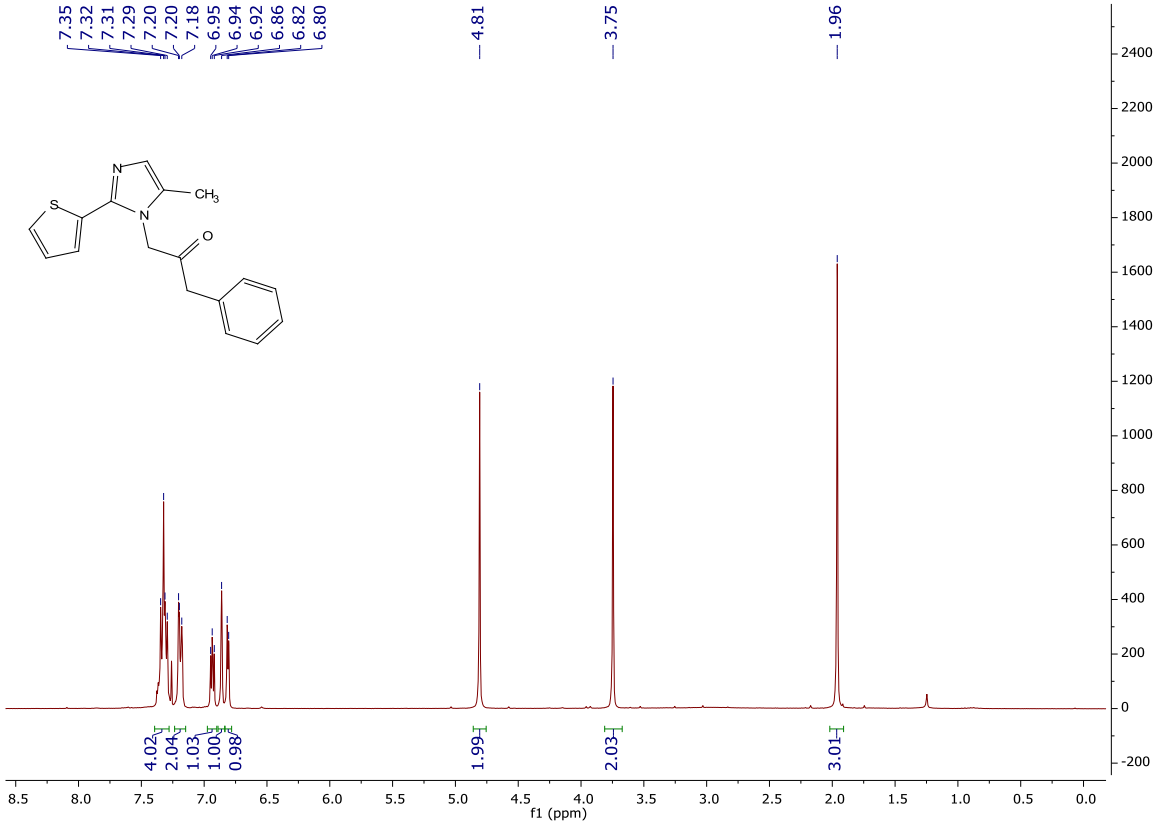


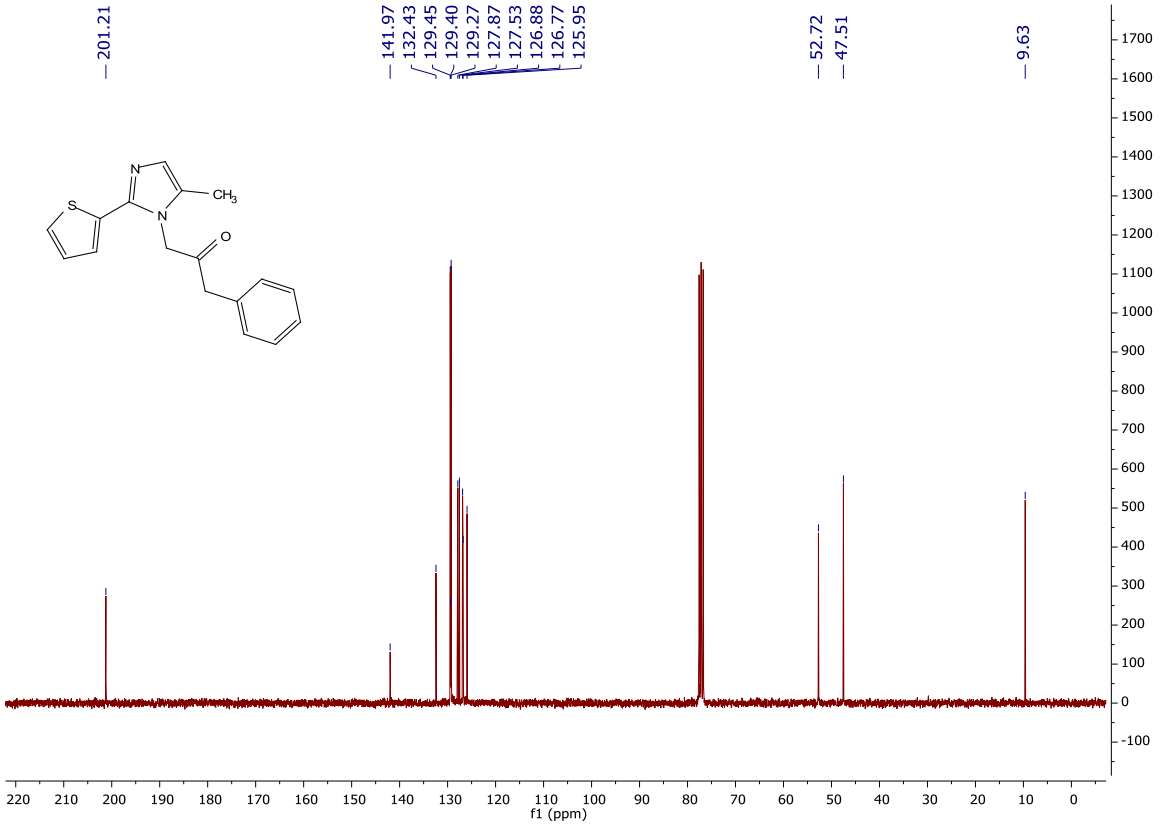
^{1}H and ^{13}C NMR spectra of compound **4f**



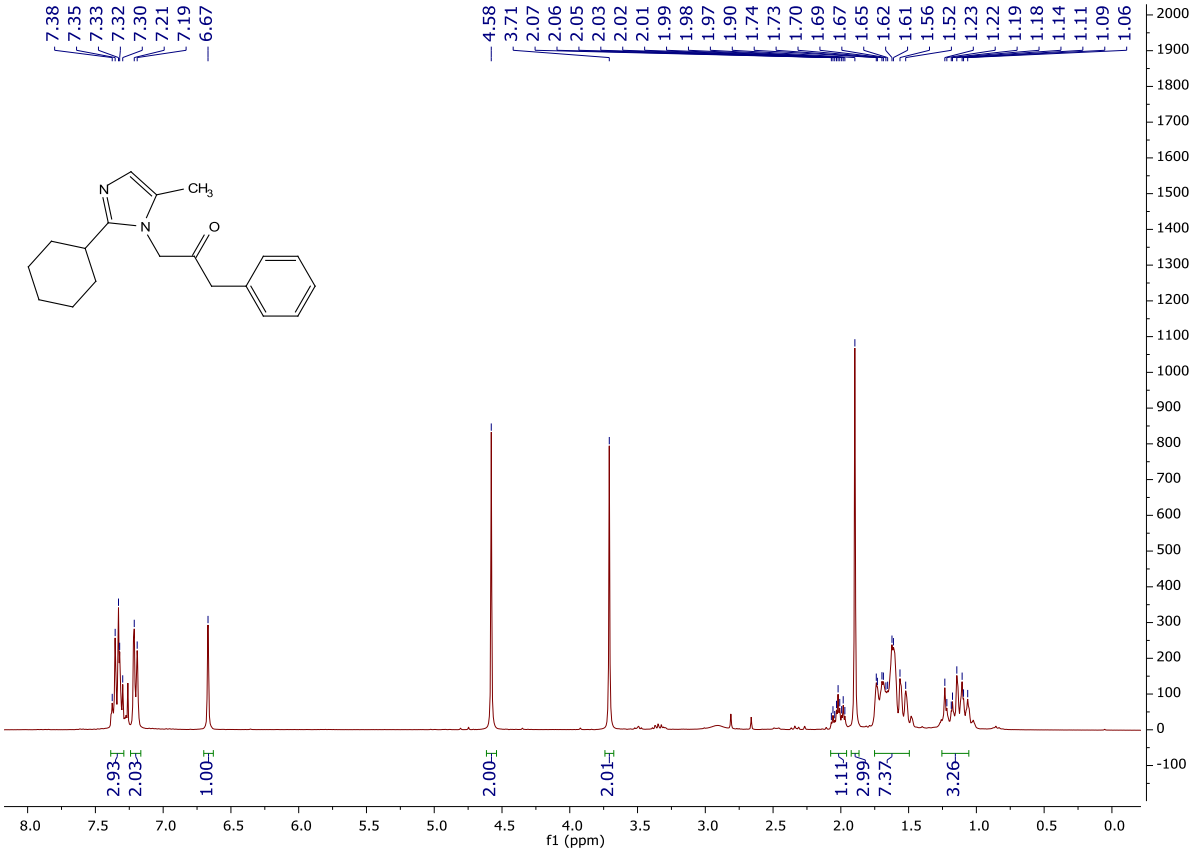


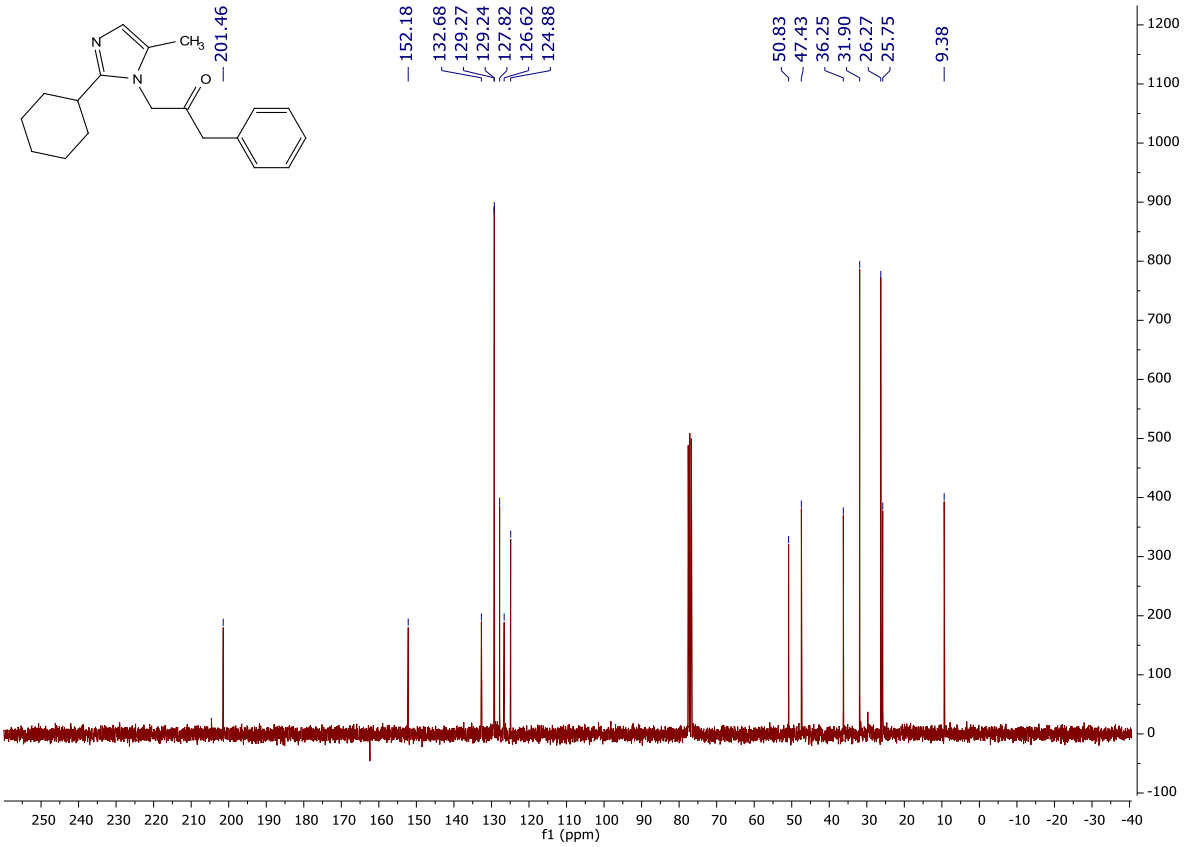
^{1}H and ^{13}C NMR spectra of compound **4g**



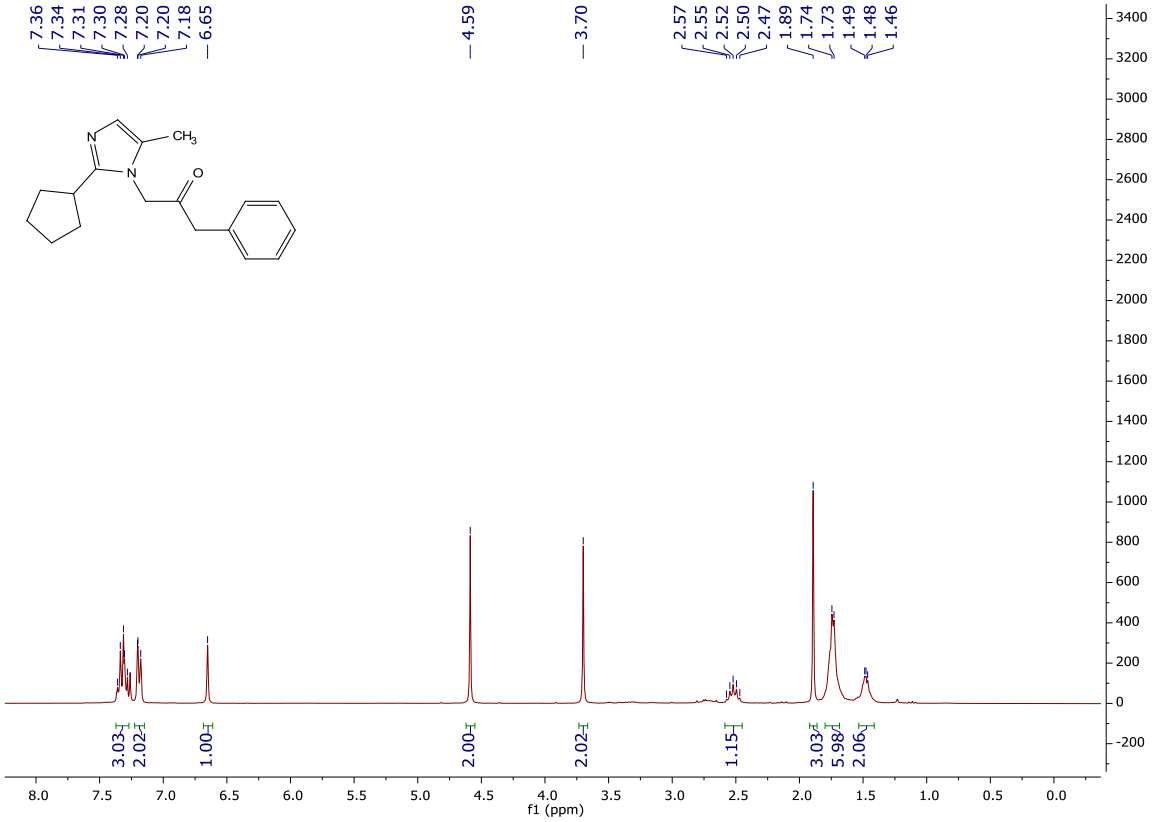


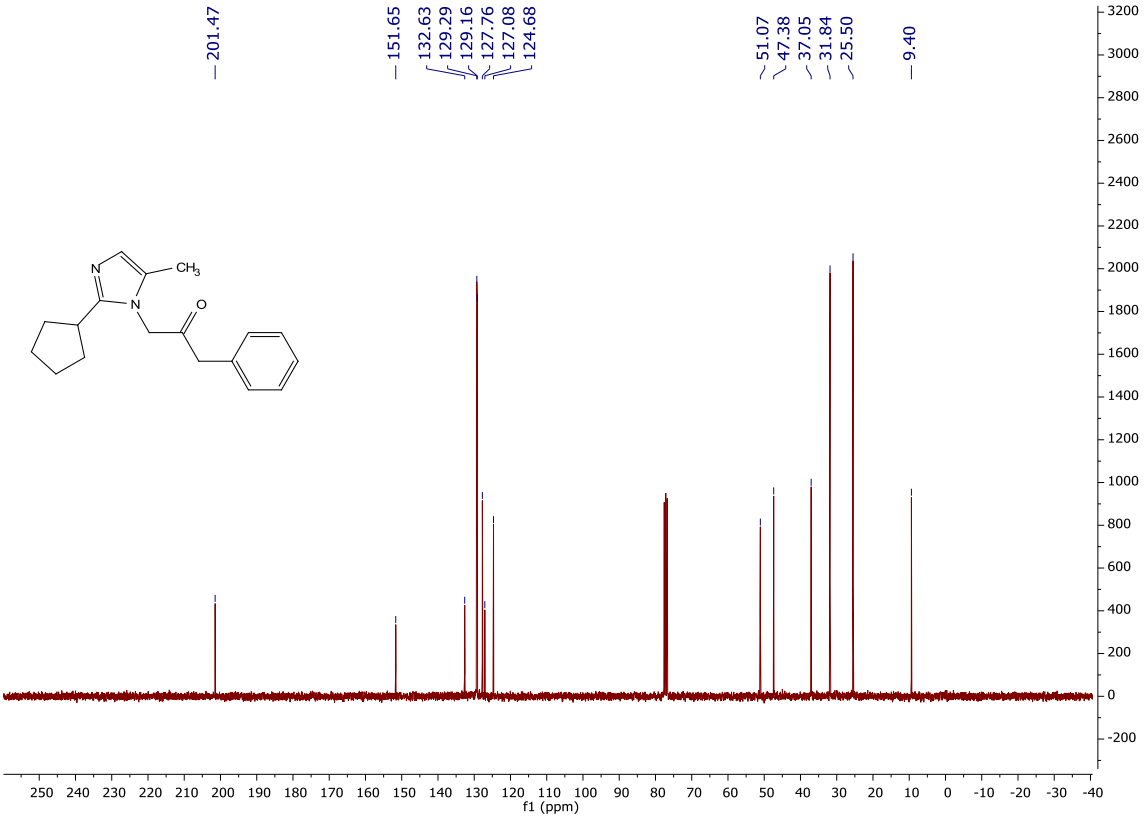
^{1}H and ^{13}C NMR spectra of compound **4h**



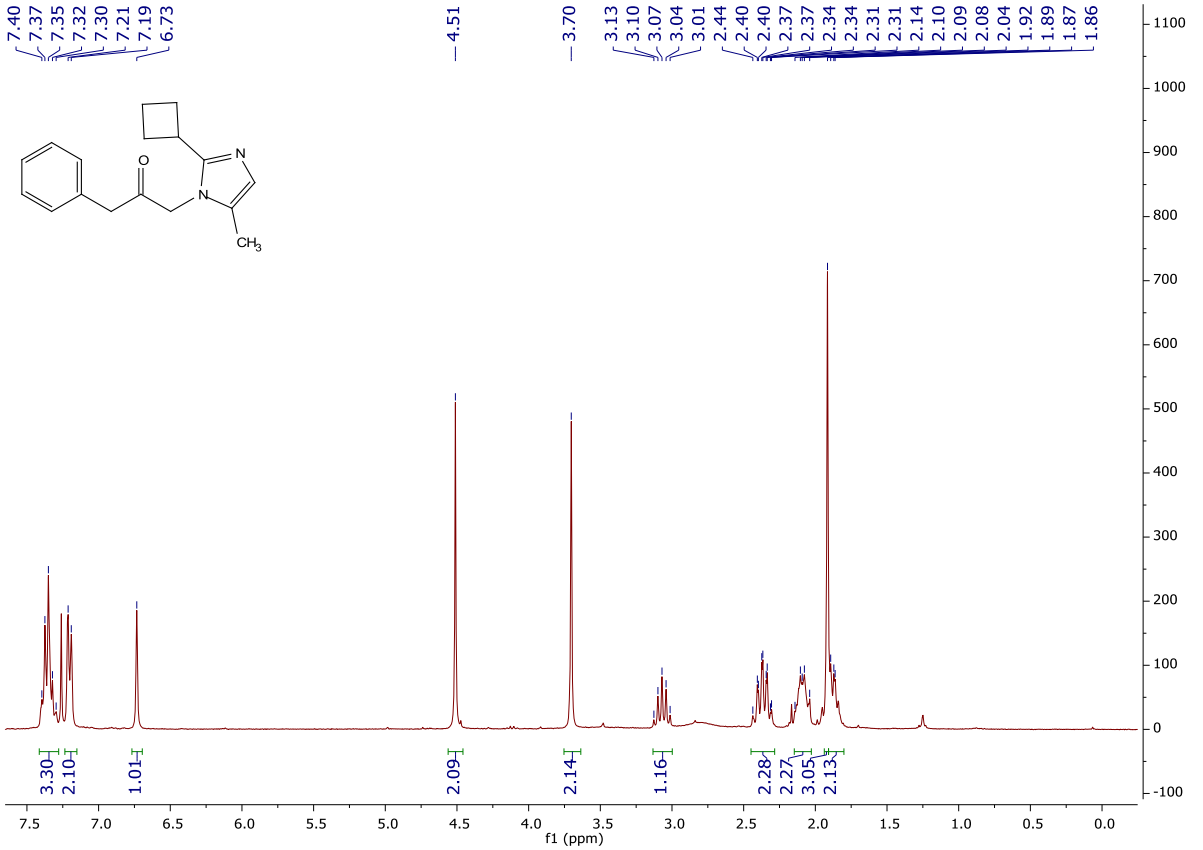


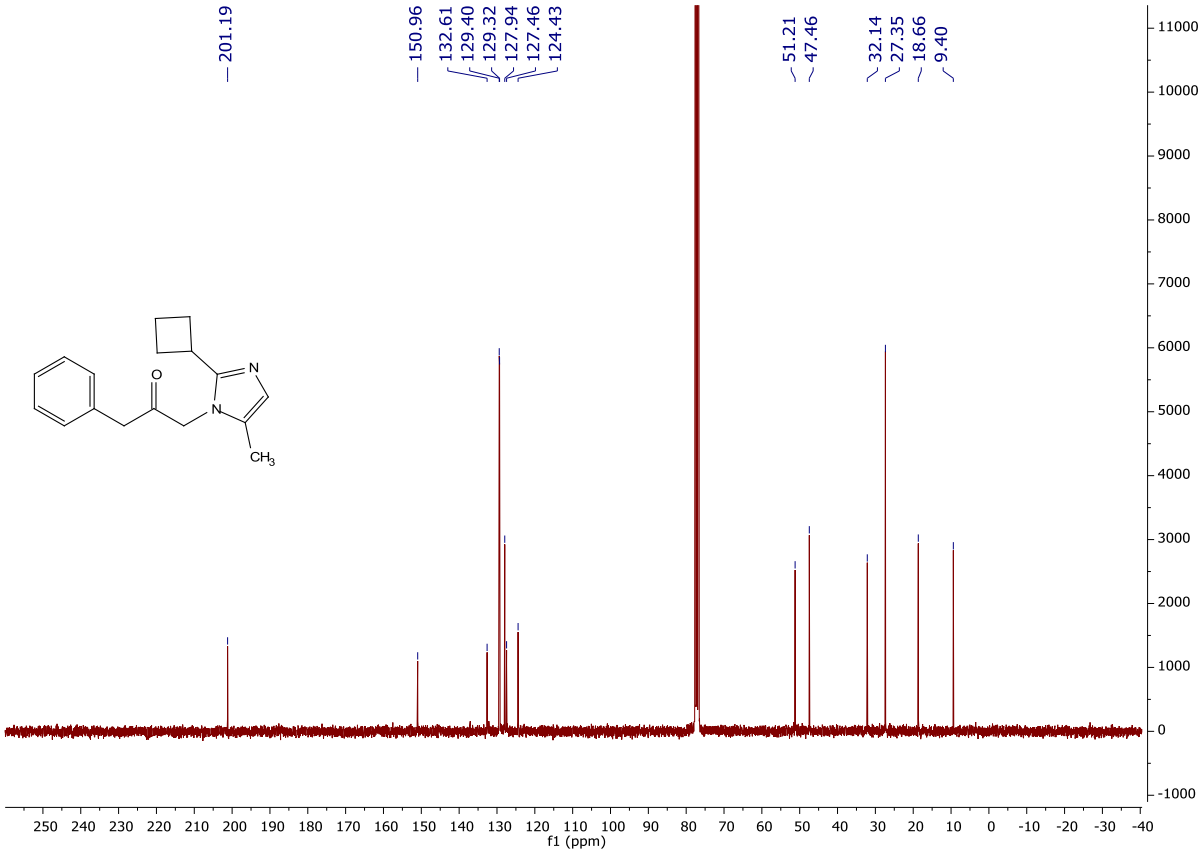
^{1}H and ^{13}C NMR spectra of compound **4i**



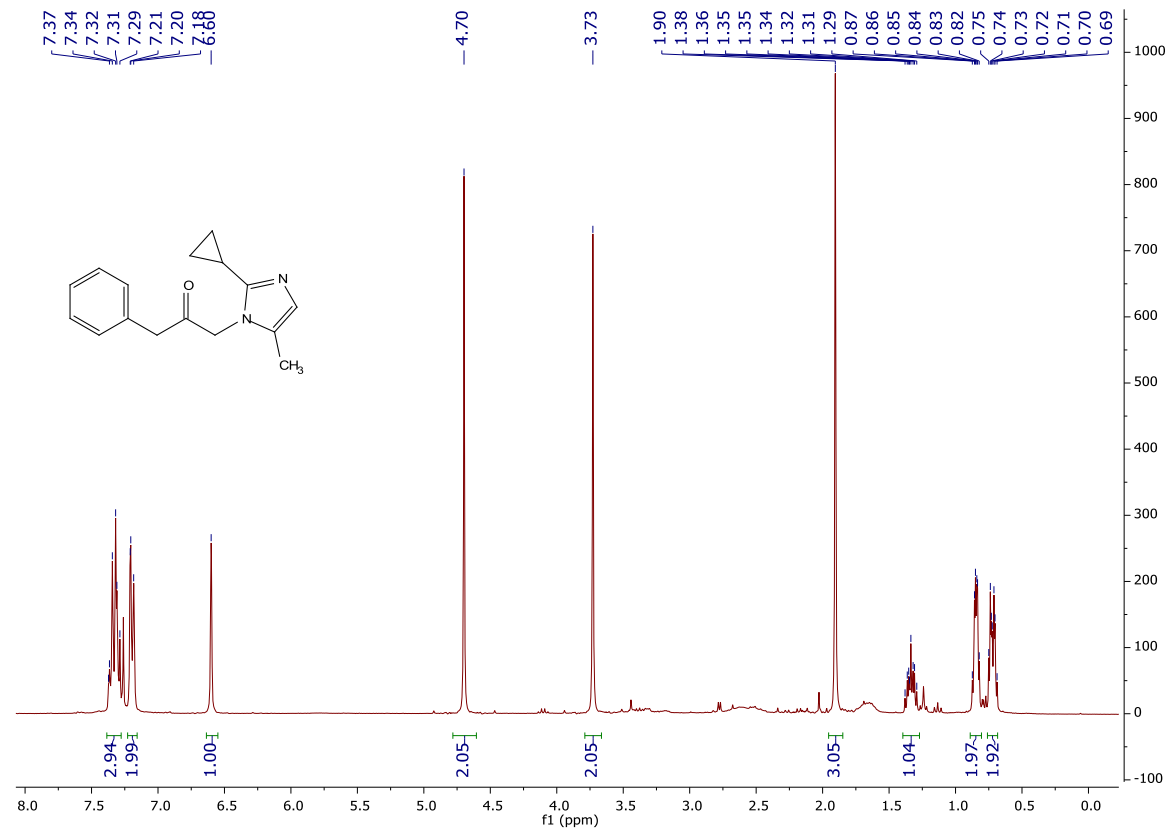


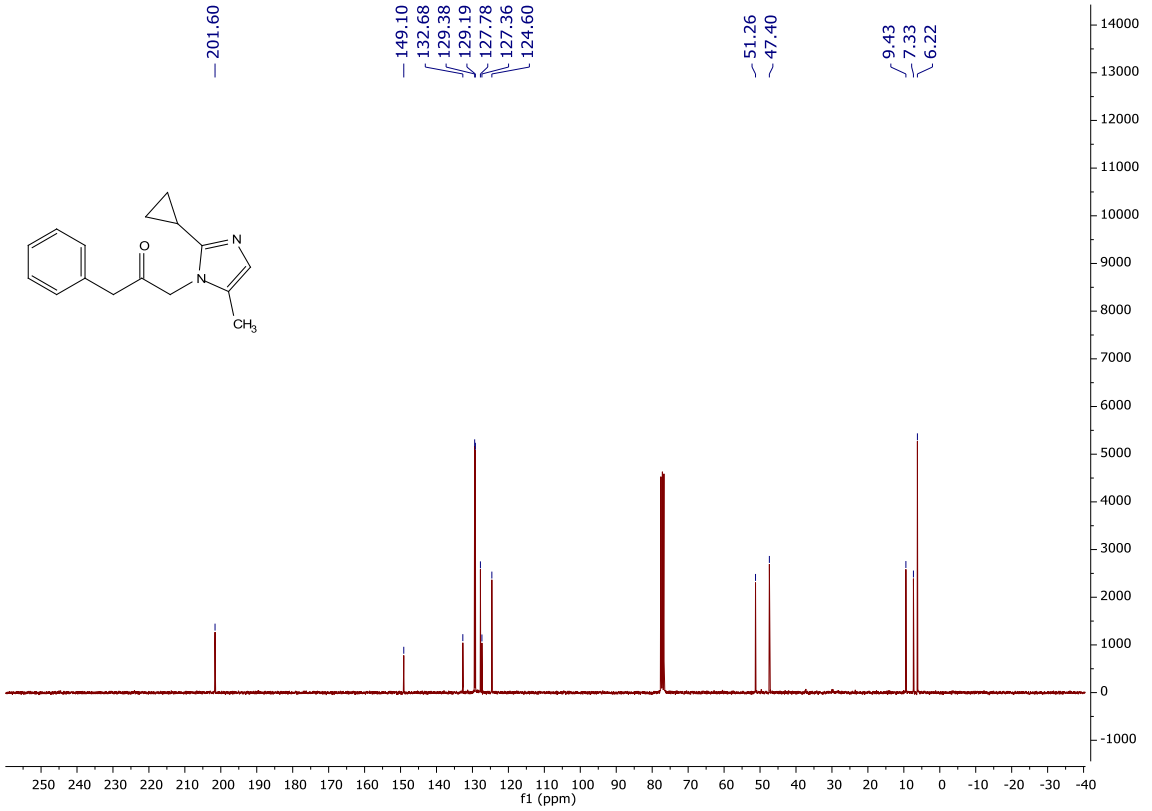
^{1}H and ^{13}C NMR spectra of compound **4j**



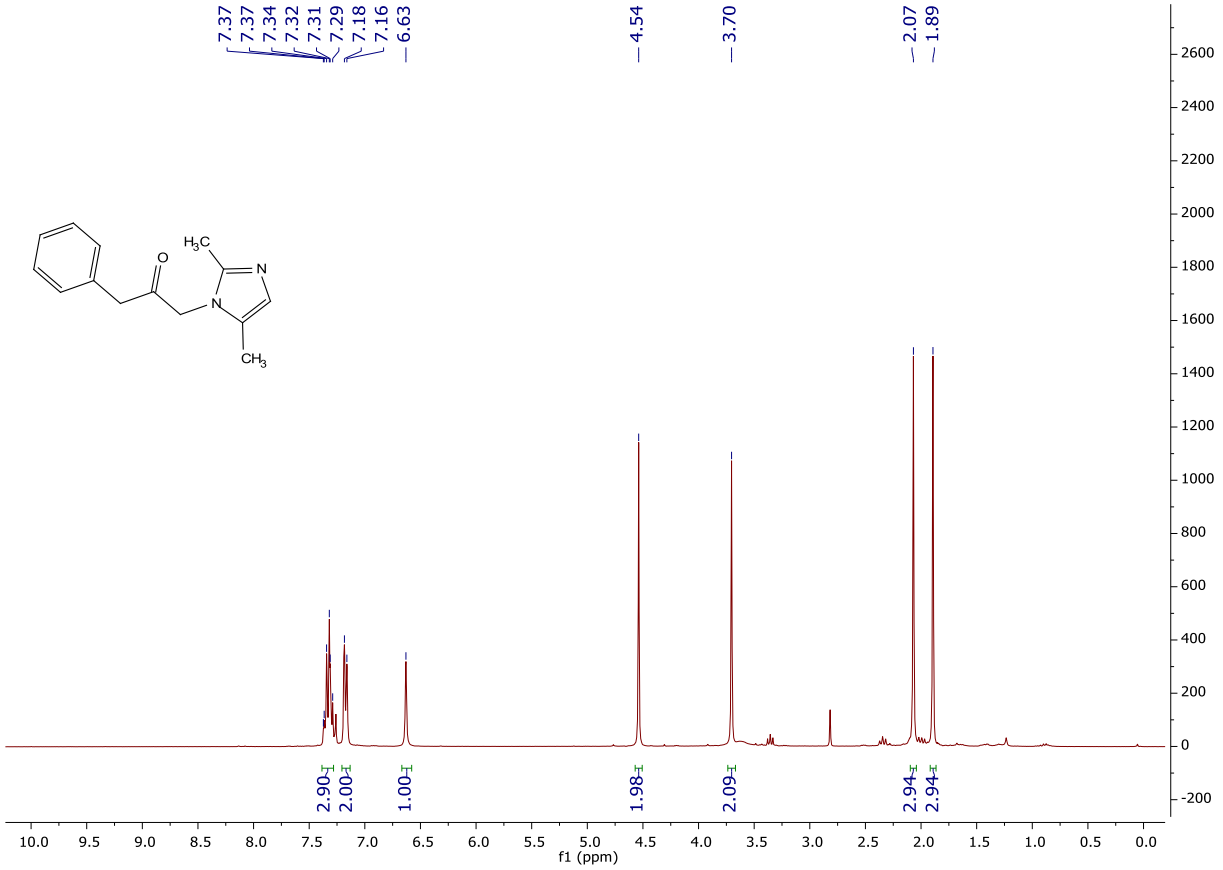


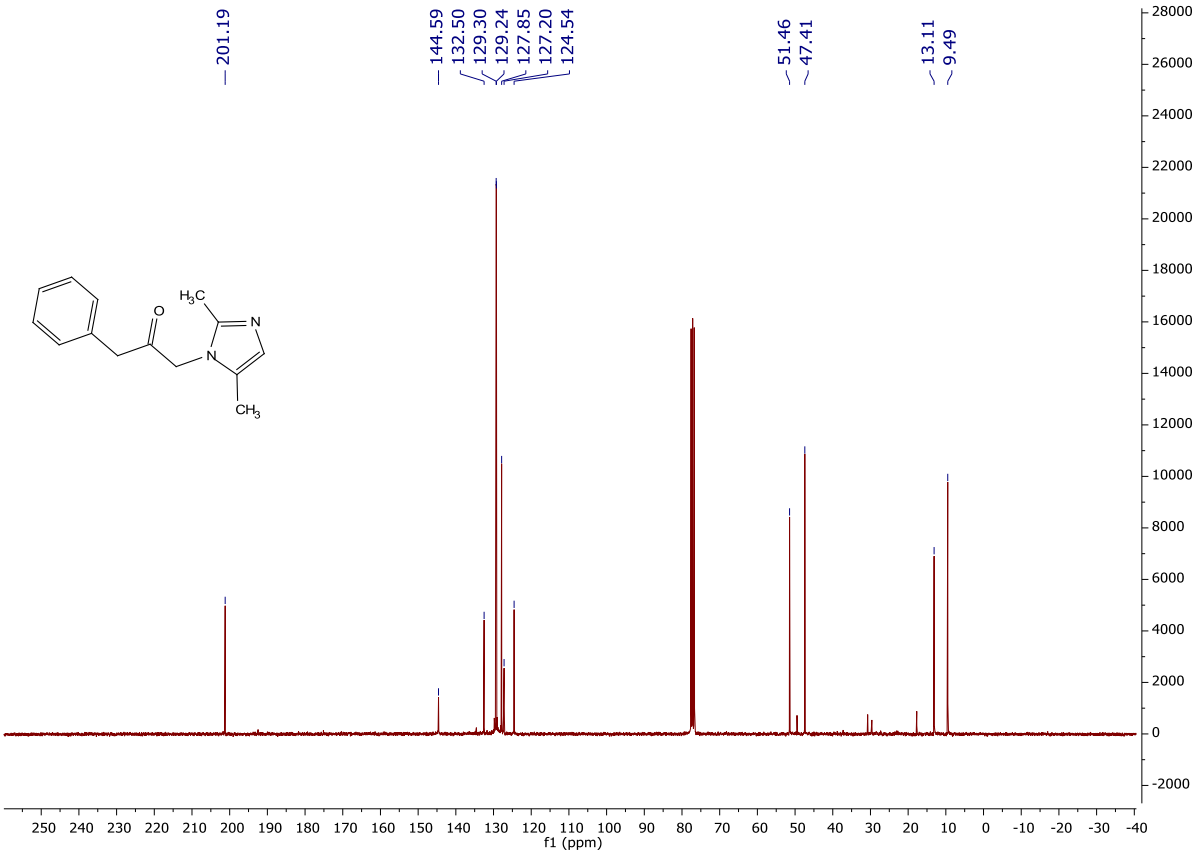
^{1}H and ^{13}C NMR spectra of compound **4k**





^{1}H and ^{13}C NMR spectra of compound **4l**





^{1}H and ^{13}C NMR spectra of compound **4m**